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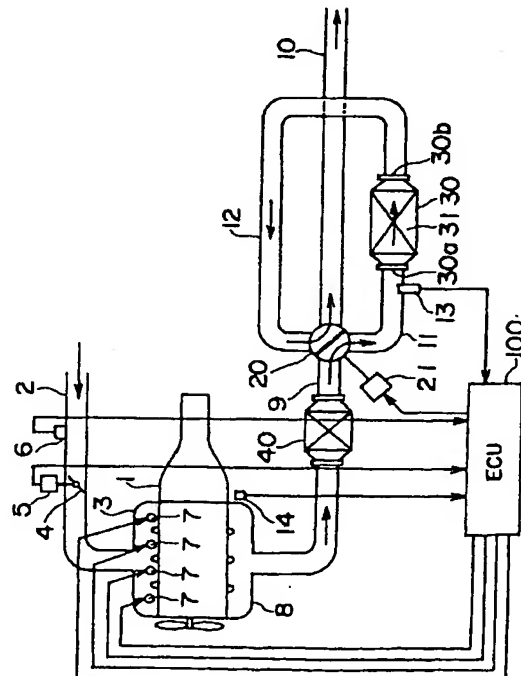
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(54) 【発明の名称】 内燃機関の排気浄化装置

(57) 【要約】

【課題】 排気浄化手段をバイパスする排気ガスの流れが生じたとしてもこれを浄化して排出することができる内燃機関の排気浄化装置を提供すること。

【解決手段】 排気浄化手段30よりも上流の排気通路に設けられた4つのポートを備えた流れ方向切替手段20は、排気浄化手段30に第1の方向に排気ガスを流す第1の位置と、第1の方向と逆の第2の方向に排気ガスを流す第2の位置と、排気浄化手段30をバイパスして排気ガスを流す第3の位置とに切り替え可能な排気浄化装置であり、流れ方向切替手段20が第1の位置と第2の位置をとることで内燃機関1から排気浄化手段30までの距離が異なる排気通路を有し、排気浄化手段30の触媒温度により流れ方向切替手段20が作動するものにおいて、排気通路9に三元触媒を設け、第1の位置から第2の位置へ流れ方向切替手段20が作動するときには内燃機関1の排気空燃比をストイキに制御する。



【特許請求の範囲】

【請求項1】 内燃機関の排気通路に排気浄化手段を有し、この排気浄化手段よりも上流の排気通路に4つのポートを備えた流れ方向切替手段が設けられ、該流れ方向切替手段の第1ポートには内燃機関に接続された第1排気通路が接続され、第2ポートには大気に接続された第2排気通路が接続され、第3ポートには前記排気浄化手段の一方側に接続された第3排気通路が接続され、第4ポートには前記排気浄化手段の他方側に接続された第4排気通路が接続されており、前記流れ方向切替手段は、前記第1ポートと前記第3ポートとを接続するとともに前記第2ポートと前記第4ポートとを接続して前記排気浄化手段に第1の方向に排気ガスを流す第1の位置と、前記第1ポートと前記第4ポートとを接続するとともに前記第2ポートと前記第3ポートとを接続して前記排気浄化手段に第1の方向と逆の第2の方向に排気ガスを流す第2の位置と、前記第1ポートと前記第2ポートとを接続して前記排気浄化手段をバイパスして排気ガスを流す第3の位置とに切り替え可能な排気浄化装置であり、前記流れ方向切替手段が前記第1の位置と第2の位置をとることで内燃機関から排気浄化手段までの距離が異なる排気通路を有し、前記排気浄化手段の触媒温度により前記流れ方向切替手段が作動するものにおいて、前記排気通路に三元触媒が設けられ、前記第1の位置から前記第2の位置へ前記流れ方向切替手段が作動するときには内燃機関の排気空燃比がストイキに制御されることを特徴とする内燃機関の排気浄化装置。

【請求項2】 前記三元触媒は前記内燃機関の排気空燃比がリーンで SO_x を吸収する SO_x 吸収機能を有し、前記第1の位置から前記第2の位置へ前記流れ方向切替手段が作動するときには内燃機関の排気空燃比をストイキに制御し、前記第3の位置に前記流れ方向切り替え手段を作動させた後に第2の位置に切り替えることを特徴とする請求項1記載の内燃機関の排気浄化装置。

【請求項3】 内燃機関の排気通路に排気浄化手段を有し、この排気浄化手段よりも上流の排気通路に4つのポートを備えた流れ方向切替手段が設けられ、該流れ方向切替手段の第1ポートには内燃機関に接続された第1排気通路が接続され、第2ポートには大気に接続された第2排気通路が接続され、第3ポートには前記排気浄化手段の一方側に接続された第3排気通路が接続され、第4ポートには前記排気浄化手段の他方側に接続された第4排気通路が接続されており、前記流れ方向切替手段は、前記第1ポートと前記第3ポートとを接続するとともに前記第2ポートと前記第4ポートとを接続して前記排気浄化手段に第1の方向に排気ガスを流す第1の位置と、前記第1ポートと前記第4ポートとを接続するとともに前記第2ポートと前記第3ポートとを接続して前記排気浄化手段に第1の方向と逆の第2の方向に排気ガスを流す第2の位置と、前記第1ポートと前記第2ポートとを

接続して前記排気浄化手段をバイパスして排気ガスを流す第3の位置とに切り替え可能な排気浄化装置であり、前記流れ方向切替手段の第1の位置と第2の位置をとることで内燃機関から排気浄化手段までの距離が異なる排気通路を有し、前記排気浄化手段の触媒温度により前記流れ方向切替手段が作動するものにおいて、排気浄化手段が排気浄化率の高い温度ウインドウ内にあるときには、前記流れ方向切り替え手段の作動を禁止することを特徴とする内燃機関の排気浄化装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、内燃機関の排気浄化装置に関し、特に、排気浄化手段を流れる排気ガスの流れ方向を必要に応じて切り替えることができる内燃機関の排気浄化装置に係るものである。

【0002】

【従来の技術】内燃機関から排出される排気ガスを浄化するために、一般に、内燃機関の排気通路には排気浄化装置が設置される。この排気浄化装置に内燃機関の排気ガスを流していると、排気浄化装置における上流側から徐々に堆積物が付着する。この堆積物が何であるかは、排気ガスの組成により、あるいは、排気浄化装置の構成および排気浄化のメカニズムにより異なり、例えば酸化物、硫化物、硝酸塩、硫酸塩などがある。この堆積物は、排気浄化装置の浄化性能を低下させたり排気抵抗の増大を招く場合があり、所定のタイミングで除去する必要がある。

【0003】例えば、リーン空燃比の燃焼を行う内燃機関から排出される排気ガスの NO_x を浄化する排気浄化装置として、吸蔵還元型 NO_x 触媒がある。この吸蔵還元型 NO_x 触媒は、流入排気ガスの空燃比がリーンのときに NO_x を吸収し、流入排気ガス中の酸素濃度が低下したときに吸収した NO_x を放出し、 N_2 に還元する触媒であり、排気通路に吸蔵還元型 NO_x 触媒を配置して、リーン空燃比の排気ガスから窒素酸化物(NO_x)を吸収させ、 NO_x 吸収後に内燃機関に供給する燃料を増量等して前記吸蔵還元型 NO_x 触媒に流入する排気ガスの空燃比をリッチにすることにより、前記吸蔵還元型 NO_x 触媒から吸収した NO_x を放出させるとともに、放出された NO_x を排気ガス中の未燃 HC 、 CO 等の還元成分により N_2 に還元浄化する。

【0004】ところで、一般に、内燃機関の燃料には硫黄分が含まれており、内燃機関で燃料を燃焼すると、燃料中の硫黄分が燃焼して硫酸酸化物(SO_x)が発生する。前記吸蔵還元型 NO_x 触媒は、 NO_x の吸収作用を行うのと同じメカニズムで排気ガス中の SO_x の吸収を行うので、内燃機関の排気通路に吸蔵還元型 NO_x 触媒を配置すると、吸蔵還元型 NO_x 触媒には NO_x のみならず SO_x も吸収される。

【0005】ところが、吸蔵還元型 NO_x 触媒に吸収さ

れたSOxは時間経過とともに安定な硫酸塩を形成するため、吸蔵還元型NOx触媒からのNOxの放出、還元浄化（以下、NOx放出・還元処理という）を行う条件では、分解、放出されにくく吸蔵還元型NOx触媒内に蓄積され易い傾向がある。吸蔵還元型NOx触媒内のSOx蓄積量が増大すると、吸蔵還元型NOx触媒のNOx吸収容量が減少して排気ガス中のNOxの除去を十分に行うことができなくなりNOx浄化効率が低下する、いわゆるSOx被毒が生じる。そこで、吸蔵還元型NOx触媒のNOx浄化能を長期に亘って高く維持するためには、触媒に吸収されているSOxを適宜のタイミングで放出させる必要がある。

【0006】吸蔵還元型NOx触媒に吸収されたSOxを放出させるには、流入排気ガスの空燃比をリッチにし、且つ、NOx放出・還元処理時よりも吸蔵還元型NOx触媒を高温にする必要があることが分かっている。

【0007】ところで、吸蔵還元型NOx触媒内のSOxの吸収量の分布は、吸蔵還元型NOx触媒においては排気ガスの入口側に近いほど多くなっており、そのため、吸蔵還元型NOx触媒に吸収されたSOxを放出させる際に、リッチ空燃比の排気ガスをNOx吸収時の排気ガスの流れ方向と同じ方向に流したのでは、吸蔵還元型NOx触媒において前記入口側に吸収されていたSOxが放出されても、放出されたSOxが吸蔵還元型NOx触媒の中を排気ガスの出口側に移動するだけで吸蔵還元型NOx触媒に再吸収されてしまい、吸蔵還元型NOx触媒から効率よく排出することができないという問題がある。

【0008】そこで、特開平7-259542号公報に開示されているように、吸蔵還元型NOx触媒に吸収されたSOxを放出させるときには、リッチ空燃比の排気ガスをNOx吸収時とは逆方向に吸蔵還元型NOx触媒に流す技術が提案されている。このように排気ガスの流れを逆にしてSOxの放出を行う逆流機能を備えていると、吸蔵還元型NOx触媒から放出されたSOxは、吸蔵還元型NOx触媒内での移動距離が少なく直ちに吸蔵還元型NOx触媒の外に排出されるようになるので、放出されたSOxが吸蔵還元型NOx触媒に再吸収されることを防止することができる。

【0009】前記公報に開示されている逆流機能付き内燃機関の排気浄化装置の場合には、吸蔵還元型NOx触媒をバイパスさせるバイパス通路を設け、吸蔵還元型NOx触媒に連なる排気通路と前記バイパス通路との合流部分にそれぞれ流路切替弁を設け、さらに、吸蔵還元型NOx触媒とこれよりも内燃機関に近い側の前記流路切替弁との間を排気ポンプの吸い込み口に接続し、排気ポンプの吐出口をバイパス通路に接続し、吸蔵還元型NOx触媒からSOxを放出させるときには、内燃機関の排気ガスの全量がバイパス通路に流れるように前記2つの流路切替弁の弁位置を切り替えるとともに、排気ポンプを運転することによって、通常のNOx吸収時とは逆方向に

吸蔵還元型NOx触媒を流れる排気の流れを発生させている。

【0010】

【発明が解決しようとする課題】この従来の逆流機能付き内燃機関の排気浄化装置では、排気ポンプや複数の流路切替弁が必要であり、部品点数が多くなって、コストアップになった。また、部品点数が多くなると、それだけ保守点検に手間がかかることになる。

【0011】また、上述した吸蔵還元型NOx触媒において逆流を伴うSOx放出処理は、SOx放出の際のSOxの移動距離を短くすることによってSOxの再吸収を回避することに着眼した処理方法ではあるが、その一方で、この処理方法を採用すると、排気ガスが吸蔵還元型NOx触媒に至るまでの距離が長くなるため、その長い経路を流通してくる間の排気ガスの温度低下が大きく、SOx放出時の温度条件の観点からすると必ずしもSOx放出に最良の方法と言えない場合もある。

【0012】そこで、本出願人は、このような逆流機能付き内燃機関の排気浄化装置を簡単な構造とし、部品点数を少なくしてコストダウンを図れるようにした技術を既に提案した（特願平11-011025）。

【0013】この技術は、内燃機関の排気通路に排気浄化手段を有し、この排気浄化手段よりも上流の排気通路に4つのポートを備えた流れ方向切替手段を設け、この流れ方向切替手段の第1ポートには内燃機関に接続された第1排気通路を接続し、第2ポートには大気に接続された第2排気通路を接続し、第3ポートには排気浄化手段の一方側に接続された第3排気通路を接続し、第4ポートには排気浄化手段の他方側に接続された第4排気通路を接続し、流れ方向切替手段は、第1ポートと第3ポートとを接続するとともに第2ポートと第4ポートとを接続して排気浄化手段に第1の方向に排気ガスを流す第1の位置と、第1ポートと第4ポートとを接続するとともに第2ポートと第3ポートとを接続して排気浄化手段に第1の方向と逆の第2の方向に排気ガスを流す第2の位置とに切り替え可能に構成したものである。

【0014】この排気浄化装置では、温度ウィンドウを持つ触媒の床温度制御を排気管の長さを利用して行うことができるように、排気ガスを流す第1の方向とその第1の方向とは逆の第2の方向との排気通路の長さを異ならせている。即ち、排気ガスを排気管に流すと放熱現象により排気ガス温度が低下し、排気通路の長さが長くなるほど温度降下は大きい。一方、排気浄化手段に用いるNOx触媒のNOx浄化率は触媒温度と相関があり、NOxを吸収する最適な温度ウィンドウを有しており、このNOx吸収温度ウィンドウから外れるとNOx吸収能力が大幅に低下する。したがって、流れ方向切替手段によって排気ガスの流れ方向を切り替えることにより、NOxの吸収及び放出制御やSOxの放出制御等を効率的に行うことができる。

【0015】しかしながら、この排気浄化装置においては、排気ガスの流れ方向を切り替えるために流れ方向切替手段の弁体を作動させると、排気ガスの流れが第1の方向から第2の方向へ、あるいは第2の方向から第1の方向へ切り替わる途中で、一時的に排気浄化手段をバイパスする流れが生じ、浄化されない排気ガスが車外に排出される問題が生じていた。

【0016】よって、本発明が解決しようとする課題の一つは、排気ガスの流れ方向切替手段の作動中に、排気浄化手段をバイパスする排気ガスの流れが生じたとしてもこれを浄化して排出することができる内燃機関の排気浄化装置を提供することにある。また、本発明が解決しようとする課題の他の一つは、排気ガスの流れ方向切替手段の切替制御において、排気浄化手段の SOx 被毒が生じないように排気ガスの流れを制御することができる内燃機関の排気浄化装置を提供することにある。また、本発明が解決しようとする課題のさらに他の一つは、流れ方向切替手段を浄化率が低い触媒活性温度範囲外で切り替えるようにすることで、排気浄化手段をバイパスする排気ガスの流れができるだけ生じないようにし、全体として排気浄化性能を向上させることができる内燃機関の排気浄化装置を提供することにある。

【0017】

【課題を解決するための手段】本発明は前記課題を解決するために、以下の手段を採用した。本発明の第1の手段は、内燃機関の排気通路に排気浄化手段を有し、この排気浄化手段よりも上流の排気通路に4つのポートを備えた流れ方向切替手段が設けられ、該流れ方向切替手段の第1ポートには内燃機関に接続された第1排気通路が接続され、第2ポートには大気に接続された第2排気通路が接続され、第3ポートには前記排気浄化手段の一方側に接続された第3排気通路が接続され、第4ポートには前記排気浄化手段の他方側に接続された第4排気通路が接続されており、前記流れ方向切替手段は、前記第1ポートと前記第3ポートとを接続するとともに前記第2ポートと前記第4ポートとを接続して前記排気浄化手段に第1の方向に排気ガスを流す第1の位置と、前記第1ポートと前記第4ポートとを接続するとともに前記第2ポートと前記第3ポートとを接続して前記排気浄化手段に第1の方向と逆の第2の方向に排気ガスを流す第2の位置と、前記第1ポートと前記第2ポートとを接続して前記排気浄化手段をバイパスして排気ガスを流す第3の位置とに切り替え可能な排気浄化装置であり、前記流れ方向切替手段が前記第1の位置と第2の位置をとることで内燃機関から排気浄化手段までの距離が異なる排気通路を有し、前記排気浄化手段の触媒温度により前記流れ方向切替手段が作動するものにおいて、前記排気通路に三元触媒が設けられ、前記第1の位置から前記第2の位置へ前記流れ方向切替手段が作動するときには内燃機関の排気空燃比がストイキに制御されることを特徴とする。

る。

【0018】この内燃機関の排気浄化装置では、流れ方向切替手段を切り替えて第1の位置あるいは第2の位置のいずれか一方を選択することによって、排気ガスを排気浄化手段に順方向に流したり、逆方向に流したりすることができる。流れ方向切替手段の作動時に、排気浄化手段をバイパスする第3の位置に切り替えられたときには、内燃機関の排気空燃比がストイキに制御されることで三元触媒が機能し、排気ガスが浄化されて排出される。したがって、排気ガスの流れ方向切替手段の作動中に、排気浄化手段をバイパスする排気ガスの流れが生じたとしてもこれを浄化して排出することができる。三元触媒については、排気浄化手段の上流側あるいは下流側のいずれの排気通路にも設けることができる。

【0019】本発明の第2の手段では、前記三元触媒は前記内燃機関の排気空燃比がリーンで SOx を吸収する SOx 吸収機能を有し、前記第1の位置から前記第2の位置へ前記流れ方向切替手段が作動するときには内燃機関の排気空燃比をストイキに制御し、前記第3の位置に前記流れ方向切替手段を作動させた後に第2の位置に切り替えることを特徴とする。

【0020】このように、三元触媒に SOx 吸収機能を持たせたものにおいては、内燃機関の排気空燃比がストイキ時に三元触媒より SOx が放出されるため、流れ方向切替手段の作動を排気バイパス位置である第3の位置で一時的に停止させ、 SOx 放出が完了してから、流れ方向切替手段を第2の位置に切り替えるように制御される。これにより、排気浄化手段の SOx 被毒を効果的に防止できる。

【0021】本発明の第三の手段では、内燃機関の排気通路に排気浄化手段を有し、この排気浄化手段よりも上流の排気通路に4つのポートを備えた流れ方向切替手段が設けられ、該流れ方向切替手段の第1ポートには内燃機関に接続された第1排気通路が接続され、第2ポートには大気に接続された第2排気通路が接続され、第3ポートには前記排気浄化手段の一方側に接続された第3排気通路が接続され、第4ポートには前記排気浄化手段の他方側に接続された第4排気通路が接続されており、前記流れ方向切替手段は、前記第1ポートと前記第3ポートとを接続するとともに前記第2ポートと前記第4ポートとを接続して前記排気浄化手段に第1の方向に排気ガスを流す第1の位置と、前記第1ポートと前記第4ポートとを接続するとともに前記第2ポートと前記第3ポートとを接続して前記排気浄化手段に第1の方向と逆の第2の方向に排気ガスを流す第2の位置と、前記第1ポートと前記第2ポートとを接続して前記排気浄化手段をバイパスして排気ガスを流す第3の位置とに切り替え可能な排気浄化装置であり、前記流れ方向切替手段の第1の位置と第2の位置をとることで内燃機関から排気浄化手段までの距離が異なる排気通路を有し、前記排気浄化手

段の触媒温度により前記流れ方向切替手段が作動するものにおいて、排気浄化手段の触媒温度が排気浄化率の高い温度ウインドウ内にあるときには、前記切替弁の作動を禁止することを特徴とする。

【0022】このように、排気ガスの流れ方向切替手段の切り替え制御に工夫を凝らすことにより、排気浄化手段をバイパスする排気ガスの流れができるだけ生じないようにし、これにより必要最低限の排気浄化手段で排気ガスを効率的に浄化できる。排気浄化手段が例えばNO_x触媒である場合、触媒活性温度内であれば、排気ガスの流れ方向切替手段は作動せず、その切替手段を第1の位置又は第2の位置の何れかに保持した状態とする。そして、触媒温度が触媒活性温度（温度ウインドウ）以上あるいは以下になったときに初めて流れ方向切替手段の切り替え制御を行う。これにより、排気浄化手段をバイパスする排気ガスの流れが存在する問題を、流れ方向切替手段の切り替え制御のみの簡便な方法で対処することができる。即ち、流れ方向切替手段をそもそも浄化率が低い触媒活性温度範囲外で切り替えるようにしているため、全体として排気浄化性能が向上する。

【0023】

【発明の実施の形態】以下、本発明に係る内燃機関の排気浄化装置の実施の形態について、図面を参照して説明する。

【第1の実施の形態】図1は、本発明に係る内燃機関の排気浄化装置を、リーン空燃比で燃焼可能なガソリンエンジン（いわゆるリーンバーンガソリンエンジン）に適用した場合の実施の形態における概略構成を示す図である。

【0024】この図において、エンジン1は直列4気筒であり、吸気管2及び吸気マニホールド3を介して各気筒に吸気が供給される。吸気管2には、図示しないアクセルペダルと連動して吸気管2内の吸気通路を開閉するスロットル弁4が設けられ、このスロットル弁4には、スロットル弁4の開度に対応した出力信号をエンジンコントロール用電子制御ユニット（ECU）100に出力するスロットルポジションセンサ5が取り付けられている。

【0025】吸気管2においてスロットル弁4よりも上流側には、吸気管2内を流れる吸入空気量（吸入空気質量）Qに対応した出力信号をECU100に出力するエアフロメータ6が取り付けられている。

【0026】エンジン1の各気筒に連なる各吸気通路には燃料噴射弁7から燃料（ガソリン）が噴射される。燃料噴射弁7の開弁時期及び開弁期間は、エンジン1の運転状態に応じてECU100によって制御される。

【0027】エンジン1の各気筒から排出される排気ガスは、排気マニホールド8及び排気管（第1排気通路）9を介して排気される。排気管9の途中には三元触媒40が設けられている。この三元触媒40は、エンジン1

の排気空燃比がストイキのときに、排気ガス中のNO_xやSO_x、HC、CO等を浄化する機能を有するものである。

【0028】排気管9は、4つのポートを備えた排気切替弁（流れ方向切替手段）20の第1ポートに接続されている。排気切替弁20の第2ポートは排気ガスを大気に排出する排気管（第2排気通路）10に接続され、排気切替弁20の第3ポートは排気管（第3排気通路）11を介して触媒コンバータ（排気浄化手段）30の入口30aに接続され、排気切替弁20の第4ポートは排気管（第4排気通路）12を介して触媒コンバータ（排気浄化手段）30の出口30bに接続されている。触媒コンバータ30には吸蔵還元型NO_x触媒（以下、NO_x触媒と略す）31が収容されている。NO_x触媒31については後で詳述する。

【0029】排気切替弁20は、その弁体を図1に示す順流位置と図2に示す逆流位置に切り替えることによって、触媒コンバータ30を流れる排気ガスの流れ方向を変えることができるバルブである。前記弁体が順流位置に位置しているとき、排気切替弁20は、排気管9と排気管11とを接続するとともに排気管10と排気管12とを接続し、この時、排気ガスは、三元触媒40→排気管9→排気管11→触媒コンバータ30→排気管12→排気管10の順に流れて、大気に放出される。このように触媒コンバータ30の入口30aから出口30bに向かって流れる排気ガスの流れを、以下の説明においては「順流」と称す。

【0030】また、排気切替弁20の弁体が図2に示す逆流位置に位置しているとき、排気切替弁20は、排気管9と排気管12とを接続するとともに排気管10と排気管11とを接続し、この時、排気ガスは、三元触媒40→排気管9→排気管12→触媒コンバータ30→排気管11→排気管10の順に流れて、大気に放出される。このように触媒コンバータ30の出口30bから入口30aに向かって流れる排気ガスの流れを、以下の説明においては「逆流」と称す。

【0031】また、排気切替弁20の弁体が図3に示す中立位置に位置しているとき、排気切替弁20は、排気管9と排気管10とを接続し、この時、排気ガスは、三元触媒40→排気管9→排気管10の順に流れて、大気に放出される。このように触媒コンバータ30を流れずにバイパスする排気ガスのながれを、以下の説明では「ショートパス」と称す。

【0032】この排気切替弁20はアクチュエータ21に駆動されて弁体位置の切り替えが行われるようになっており、アクチュエータ21はECU100により制御される。この実施の形態では、アクチュエータ21とECU100は制御手段を構成する。排気切替弁20の弁体位置の切り替え制御については後で詳述する。

【0033】排気管11において触媒コンバータ30の

入口30aの近傍には、排気管11内を流れる排気ガスの温度に対応した出力信号をECU100に出力する排気温度センサ13が取り付けられている。

【0034】ECU100はデジタルコンピュータとなり、双方向バスによって相互に接続されたROM（リードオンメモリ）、RAM（ランダムアクセスメモリ）、CPU（セントラルプロセッサユニット）、入力ポート、出力ポートを具備し、エンジン1の空燃比制御等の基本制御を行うほか、この実施の形態では、触媒コンバータ30のSOx放出処理制御等を行っている。

【0035】これら制御のために、ECU100の入力ポートには、前記エアフロメータ6からの入力信号、排気温度センサ13からの入力信号が入力されるほか、回転数センサ14からの入力信号が入力される。回転数センサ14はエンジン1の回転数に応じた出力信号をECU100に出力し、この出力信号からECU100はエンジン回転数Nを演算する。また、ECU100はエアフロメータ6の出力信号から吸入空気量Qを演算し、エンジン負荷Q/N（吸入空気量Q/エンジン回転数N）を演算する。そして、ECU100は、エンジン回転数Nとエンジン負荷Q/Nからエンジン1の運転状態を判定し、その運転状態に応じて燃料噴射弁から噴射する燃料量を制御し、リーン空燃比とストイキまたはリッチ空燃比に切り替える空燃比制御を行う。この空燃比制御の一例を挙げれば、暖機運転時および高負荷運転域ではストイキまたはリッチ空燃比とし、低中負荷運転域ではリーン空燃比とする制御方法がある。

【0036】触媒コンバータ30に収容されているNOx触媒31、即ち吸蔵還元型NOx触媒は例えばアルミナを担体とし、この担体上に例えばカリウムK、ナトリウムNa、リチウムLi、セシウムCsのようなアルカリ金属、バリウムBa、カルシウムCaのようなアルカリ土類、ランタンLa、イットリウムYのような希土類から選ばれた少なくとも一つと、白金Ptのような貴金属とが担持されている。

【0037】このNOx触媒31は、流入排気ガスの空燃比（以下、排気空燃比と称す）がリーンのときはNOxを吸収し、流入排気ガス中の酸素濃度が低下すると吸収したNOxを放出し、N₂に還元する。尚、排気空燃比とは、ここではNOx触媒31の上流側の排気通路やエンジン燃焼室、吸気通路等にそれぞれ供給された空気量の合計と燃料（炭化水素）の合計の比を意味するものとする。したがって、NOx触媒31上流の排気通路内に燃料、還元剤あるいは空気が供給されない場合には、排気空燃比はエンジン燃焼室内に供給される混合気の空燃比に一致することになる。

【0038】この実施の形態では、リーン空燃比での燃焼が可能ないわゆるリーンバーンガソリンエンジンを内燃機関として使用しており、エンジン1の運転状態に応じて混合気の空燃比を制御している。それゆえ、エンジ

ン1がリーン空燃比で運転されている時には排気空燃比はリーンになり、酸素濃度は高くなる。一方、エンジン1がストイキまたはリッチ空燃比で運転されている時には排気空燃比はストイキまたはリッチになり、排気ガス中の酸素濃度は大幅に低下するとともに、エンジン1から排出される未燃HC、CO等の成分が増大する。

【0039】NOx触媒31のNOx吸放出作用のメカニズムについては明らかでない部分もあるが、図4に示すようなメカニズムで行われると考えられている。このメカニズムについて、担体上に白金Pt及びバリウムBaを担持させた場合を例にとりて説明するが、他の貴金属、アルカリ金属、アルカリ土類、希土類を用いても同様のメカニズムとなる。

【0040】まず、流入排気ガスがかなりリーンになると流入排気ガス中の酸素濃度が大幅に増大するため、図4（A）に示すように、酸素O₂がO₂⁻又はO₂²⁻の形で白金Ptの表面に付着する。次に、排気ガスに含まれるNOは、白金Ptの表面上でO₂⁻又はO₂²⁻と反応し、NO₂となる（2NO+O₂→2NO₂）。

【0041】その後、生成されたNO₂は、NOx触媒31のNOx吸収能力が飽和しない限り、白金Pt上で酸化されながらNOx触媒31内に吸収されて酸化バリウムBaOと結合し、図4（A）に示すように硝酸イオンNO₃⁻の形でNOx触媒31内に拡散する。このようにしてNOxがNOx触媒31内に吸収される。

【0042】これに対し、流入排気ガス中の酸素濃度が低下した場合は、NO₂の生成量が低下し、前記反応とは逆の反応（NO₃⁻→NO₂）によって、NOx触媒31内の硝酸イオンNO₃⁻は、NO₂またはNOの形でNOx触媒31から放出される。

【0043】一方、流入排気ガス中にHC、CO等の還元成分が存在すると、これらの成分は白金Pt上の酸素O₂⁻又はO₂²⁻と反応して酸化され、排気ガス中の酸素を消費して排気ガス中の酸素濃度を低下させる。また、排気ガス中の酸素濃度低下によりNOx触媒31から放出されたNO₂またはNOは、図4（B）に示すように、HC、COと反応して還元される。このようにして白金Pt上のNO₂またはNOが存在しなくなると、NOx触媒31から次から次へとNO₂またはNOが放出される。

【0044】即ち、流入排気ガス中のHC、COは、まず白金Pt上の酸素O₂⁻又はO₂²⁻とただちに反応して酸化せしめられ、次いで白金Pt上の酸素O₂⁻又はO₂²⁻が消費されてもまだHC、COが残っていれば、このHC、COによってNOx触媒31から放出されたNOxおよびエンジンから排出されたNOxがN₂に還元せしめられる。

【0045】このように、排気空燃比がリーンになるとNOxがNOx触媒31に吸収され、排気空燃比をストイキあるいはリッチにするとNOxがNOx触媒31から短

時間のうちに放出され、 N_2 に還元される。したがって、大気中への NO_x の排出を阻止することができる。

【0046】次に、 NO_x 触媒31の SO_x 被毒のメカニズムについて説明する。排気ガス中に硫酸化物(SO_x)が含まれていると、 NO_x 触媒31は上述の NO_x の吸収と同じメカニズムで排気ガス中の SO_x を吸収する。即ち、排気空燃比がリーンのときには、酸素 O_2 が O_2^- 又は O_2^{2-} の形で NO_x 触媒31の白金Ptの表面に付着しており、流入排気ガス中の SO_x (例えば SO_2)は白金Ptの表面上で酸化されて SO_3 となる。

【0047】その後、生成された SO_2 は、白金Ptの表面で更に酸化されながら NO_x 触媒31内に吸収されて酸化バリウムBaOと結合し、硫酸イオン SO_4^{2-} の形で NO_x 触媒31内に拡散し硫酸塩 $BaSO_4$ を形成する。 $BaSO_4$ は結晶が粗大化し易く、比較的安定し易いため、一旦生成されると分解放出されにくい。このため、時間の経過とともに NO_x 触媒31中の $BaSO_4$ の生成量が増大すると NO_x 触媒31の吸収に関与できるBaOの量が減少して NO_x の吸収能力が低下してしまう。これが即ち SO_x 被毒である。したがって、 NO_x 触媒31の NO_x 吸収能力を高く維持するためには、適宜のタイミングで NO_x 触媒31に吸収された SO_x を放出させる必要がある。

【0048】 NO_x 触媒31から SO_x を放出させるには、 NO_x を放出させる場合と同様に排気ガスの酸素濃度を低下させればよいことが分かっており、また、 NO_x 触媒31の温度が高いほど放出し易いことが分かっている。

【0049】本出願人の研究により、 NO_x 触媒31に吸収された SO_x を放出させるには、流入排気空燃比をストイキまたはリッチにし、且つ、 NO_x 触媒31から NO_x を放出させる通常の NO_x 放出・還元処理時よりも NO_x 触媒31の温度を高くする必要があることがわかった。

【0050】また、触媒コンバータ30における SO_x の吸収状態は、触媒コンバータ30の入口30aに近く位置している NO_x 触媒31の方が、入口30aから遠くに位置している NO_x 触媒31よりも SO_x 吸収量が多くなるため、 NO_x 触媒31から SO_x を放出させる際には、排気空燃比がストイキまたはリッチで且つ高温の排気ガスを触媒コンバータ30の出口30b側から入口30a側に向けて流すと、 SO_x を短時間で放出することができる。

【0051】触媒コンバータ30の排気通路への配置位置については、排気ガスの流れが順流のときの NO_x 触媒床温度を確保するため、触媒コンバータ30の入口30aが排気切替弁20の近くに位置する配置としている。即ち、排気切替弁20の弁体を順流位置に位置させた状態を示す図1と、排気切替弁20の弁体を逆流位置に位置させた状態を示す図2とからもわかるように、排

気ガスが触媒コンバータ30に流入するまでの流路長さは、排気切替弁20の弁体を順流位置にしたときの方が、弁体を逆流位置にしたときよりも短い。そのため、排気ガスを排気管に流すと放熱現象により排気ガス温度が低下し、流路長さが長くなるほど温度降下は大きい。したがって、排気切替弁20の弁体を順流位置に位置させたときよりも、弁体を逆流位置に位置させたときの方が触媒コンバータ30に流入するまでの排気ガスの温度降下が大きい。

【0052】一方、図5に示すように、 NO_x 触媒31の NO_x 浄化率は触媒温度と相関があり、 NO_x を吸収するのに最適な温度ウィンドウ(以下 NO_x 吸収ウィンドウという)を有しており、この NO_x 吸収ウィンドウから外れると NO_x 吸収能力が大幅に低下する。また、 NO_x 触媒31から NO_x を放出・還元させるときには、 NO_x 触媒31の温度をそれほど高くしなくても NO_x を放出させることができるものの、 NO_x 触媒31から SO_x を放出させるときには、前述したように NO_x 触媒31の温度を高温にした方が SO_x を効率的に放出することができる。

【0053】他方、排気切替弁20の弁体を作動させると、弁体作動中に排気ガスが図3に示すようにショートパスして触媒コンバータ30をバイパスするために、排気空燃比がリーンであるとその排気ガスが三元触媒によって浄化されない。

【0054】そこで、本実施の形態では、排気ガスの流れ方向を順流あるいは逆流とする際に必要な排気切替弁20の切替操作に基づく弁体作動中に、排気ガスがショートパスする弁体位置(第3の位置)では、排気空燃比をストイキに制御することとした。この弁体の作動を伴う排気切替弁20の切替操作については、例えば、 NO_x 、 SO_x の吸収時には触媒コンバータ30における排気ガスの流れを順流にし、 NO_x 、 SO_x の放出時には触媒コンバータ30における排気ガスの流れを逆流にすると、あるいは NO_x 触媒31の NO_x 浄化率が触媒温度と相関する点を考慮し、触媒温度が温度ウィンドーから外れないように排気ガスの流れ方向を順流又は逆流に切り替えるとき、などを例示することができる。

【0055】次に、本実施の形態における排気浄化装置の作動について、 NO_x あるいは SO_x 放出時に排気ガスを逆流させる制御を例にとり説明する。前述したように、エンジン1はリーンバーンガソリンエンジンであり、エンジン1の運転状態に応じて空燃比がECU10により制御され、エンジン1がリーン空燃比で運転されている時には排気空燃比はリーンになって、酸素濃度は高くなり、エンジン1がストイキまたはリッチ空燃比で運転されている時には排気空燃比はストイキまたはリッチになり、排気ガス中の酸素濃度は大幅に低下するとともに、エンジン1から排出される未燃HC、CO等の成分が増大する。

【0056】そこで、エンジン1がリーン空燃比で運転されているときには、排気切替弁20の弁体が図1に示す順流位置に保持されるように、ECU100によってアクチュエータ21の作動を制御する。これにより、エンジン1の排気ガスは、三元触媒40→排気管9→排気管11→触媒コンバータ30→排気管12→排気管10の順に流れて、大気に放出されるようになり、触媒コンバータ30では入口30aから出口30bに向かって流れる順流となる。この時、排気ガス中のNOx及びSOxが触媒コンバータ30のNOx触媒31に吸収される。またこの時、排気空燃比がリーンであるため三元触媒40はほとんど機能しない。

【0057】そして、エンジン1がストイキ又はリッチ空燃比で運転されているときには、排気切替弁20の弁体が図2に示す逆流位置に保持されるように、ECU100によってアクチュエータ21の作動を制御する。これにより、エンジン1の排気ガスは、三元触媒40→排気管9→排気管12→触媒コンバータ30→排気管11→排気管10の順に流れて、大気に放出されるようになり、触媒コンバータ30では出口30bから入口30aに向かって流れる逆流となる。また、エンジン1をストイキまたはリッチ空燃比で運転している時には、NOx触媒31からSOxが放出され易い排気ガス温度となるように、ECU100によってエンジン1の運転制御がなされるようにしておく。

【0058】これにより、触媒コンバータ30内をストイキまたはリッチ空燃比の高温の排気ガスが、NOx、SOx吸収時とは逆の方向に通過するようになり、NOx触媒31からNOxが放出され、さらに排気ガス中の未燃HC、CO等によりN2に還元浄化される。また、排気ガスが触媒コンバータ30を逆流することによって、NOx触媒31に吸収されているSOxを短時間のうちにNOx触媒31から放出させることができる。

【0059】また、エンジン1の運転条件によりリーン空燃比運転が長時間続いた時には、エンジン1を強制的にストイキまたはリッチ空燃比で運転されるように制御して上述のようにNOx、SOxの放出処理を行い、触媒コンバータ30がNOxやSOxで飽和しないようにする。このようなエンジン1の空燃比制御方法を以下の説明ではリーン・リッチスパイク制御と称す。尚、リーン・リッチスパイク制御について具体的に数値を挙げて説明すると、エンジン1の「リーン空燃比運転」が数十秒（例えば40～60秒）続くと、「ストイキまたはリッチ空燃比運転」が数秒（例えば2～3秒）続き、この「リーン空燃比運転」と「ストイキまたはリッチ空燃比運転」が交互に実行されるといった具合である。

【0060】このように排気切替弁20の弁体が順流位置から逆流位置にあるいは逆流位置から順流位置に切り替わる途中では、図3に示すように排気ガスが排気管9から排気管10へとショートパスして触媒コンバータ3

0をバイパスする。このとき、ショートパスする排気ガスがリーンであると、三元触媒40は機能せず、排気ガスは浄化されない。したがって、排気切替弁20の弁体作動中においては、エンジン1の運転制御により、排気空燃比を強制的にストイキに制御して三元触媒40を機能させ、ショートパスする排気ガスを三元触媒40により浄化してから大気に放出させる。

【0061】図6は、このようにエンジン1の運転制御により、排気空燃比を強制的にストイキに制御するときにはECU100が実行する制御手順を示すフローチャートである。まず、ステップS1では、ECU100はバルブ作動時期か否かを判定する。この判定については、どのような条件を満たしたときに排気ガスの流れ方向を切り替えるか否か、排気浄化の全体システムや排気浄化手段の特性によって決定されるが、例えばECU100がエンジン1の運転時間を積算し、その積算値が所定量に達した場合にSOx放出処理必要と判定したり、ECU100がNOx触媒31に吸収されたSOx量を積算し、積算値が所定量に達した時にSOx放出必要と判定するなどを例示することができる。また、リーン空燃比で燃焼可能なリーンバーンガソリンエンジンの場合には、エンジン1の運転状態によってリーン空燃比による燃焼とリッチ空燃比による燃焼に切り替えられるので、このエンジン1の運転状態に応じて排気切替弁20を切替制御する場合なども例示することができる。

【0062】ステップS1において、バルブ作動時期でないことを判定したらリターンしてスタートへ戻る。バルブ作動時期であることを判定した場合には、ステップS2においてエンジン1の排気空燃比を強制的にストイキに制御する。エンジン1の排気空燃比をストイキに制御したら、次にステップS3において、アクチュエータ21の作動制御により排気切替弁20の弁体（バルブ）を順流位置から逆流位置へ切り替える。

【0063】バルブの切り替え制御を完了したら、ステップS4に移行する。ステップS4では、ECU100はエンジン1の運転状態に応じた空燃比に、あるいは強制的にリーン・リッチスパイク運転等に制御する。ステップS4へ移行後はリターンしてスタートへ戻る。

【0064】なお、バルブ作動中において、エンジン1の排気空燃比を強制的にストイキに制御することは、NOx触媒31のNOx浄化率が触媒温度と相関する点を考慮し、触媒温度が温度ウィンドーから外れないように排気ガスの流れ方向を順流又は逆流に切り替えるときにおいても同様である。

【0065】この実施の形態では、排気ガスが順流に流れる方向が第1の方向となり、逆流に流れる方向が第2の方向となる。また、排気管9、排気管11、排気管12、排気管10、排気切替弁20、アクチュエータ21、ECU100等は排気ガスの逆流手段を構成している。また、SOx除去に必要な排気ガスの空燃比（リー

ン又はリッチ)と排気ガス温度(高温)をエンジン1の運転制御によって得ているので、この実施の形態ではエンジン1の運転制御を行うための各センサーを含むECU100が制御手段を構成している。

【0066】また、この実施の形態では、三元触媒40を触媒コンバータ30の上流側に設けた例を示したが、三元触媒40を触媒コンバータ30の下流側に設けてもよい。三元触媒40を触媒コンバータ30の下流側に設ける例としては、排気管10の途中に設ける例を挙げることができる。

【0067】〔実施の形態2〕次に、本発明に係る内燃機関の排気浄化装置の第2の実施の形態について、図7のフロー図を参照して説明する。

【0068】この第2の実施の形態では、第1の実施の形態で示した三元触媒40に、ストラップ材の機能を持たせた場合における制御例を示したものである。この場合の三元触媒40は、流入排気ガスの空燃比がリーンのときにSOxを吸収し、酸素濃度の低いストイキ又はリッチ空燃比のときに吸収したSOxを放出する。

【0069】このように三元触媒40にストラップ機能を持たせると、図1に示すように排気切替弁20の弁体を順流位置にしたとき(即ち、NOx吸収時)には、三元触媒40が触媒コンバータ30よりも上流に位置することになるので、排気ガス中のSOxは三元触媒40に吸着され、触媒コンバータ30へのSOxの流入を阻止することができる。しかし、エンジン1の排気空燃比をストイキに制御すると、三元触媒40からSOxが放出されるため、NOx触媒31のSOx被毒の問題が生じる。

【0070】そこで、この実施の形態では、ECU100は次のように排気切替弁20の弁体位置の切り替え制御を行う。まず、ステップS11において、ECU100はバルブ作動時期か否かを判定する。バルブ作動時期でないことを判定したらリターンしてスタートへ戻る。バルブ作動時期であることを判定した場合には、ステップS12に進み、エンジン1の排気空燃比を強制的にストイキに制御するとともに、アクチュエータ21の作動制御により排気切替弁20の弁体(バルブ)を順流位置から逆流位置へ切り替える途中で、バルブをバイパス位置(第3の位置)に位置させる。

【0071】排気空燃比がストイキに制御されると、三元触媒40からSOxが放出されるが、バルブがバイパス位置にあるため、SOxを含む排気ガスはNOx触媒31をバイパスして大気へ放出される。これによりNOx触媒31のSOx被毒が防止される。

【0072】ステップS12の実行により、バルブをバイパス位置に位置させた状態でステップS13へ移行する。このステップS13では、三元触媒40のSOx放出が完了したか否かを判定し、SOx放出未完了と判定した場合はステップS12へ戻る。SOx放出完了と判

定した場合はステップS14へ進み、目的とするバルブ切替位置(逆流位置)へ切り替えてバルブの切替制御を完了する。

【0073】ステップS14においてバルブの切り替え制御を完了するとステップS15へ移行する。ステップS15では、ECU100はエンジン1をその運転状態に応じた空燃比に、あるいは強制的にリーン・リッチスパイク運転等に制御する。ステップS15移行後はリターンしてスタートへ戻る。

【0074】なお、以上の制御フローは、バルブを逆流位置から順流位置へ切り替える場合においても同様に実行される。また、このようにエンジン1の排気空燃比を強制的にストイキに制御するとき、バルブの作動を一旦排気バイパス位置で停止させることは、NOx触媒31のNOx浄化率が触媒温度と相関する点を考慮し、触媒温度が温度ウィンドーから外れないように排気ガスの投げれ方向を順流又は逆流に切り替えるときにおいても同様に実行される。

【0075】尚、上述した実施の形態では、NOx触媒31からのNOx、SOxの放出処理を同時に行っているが、エンジンの排気ガス、特にガソリンエンジンの排気ガスに含まれるSOx量は極めて僅かであるため、NOxの放出処理と同一の頻度でSOxの放出処理を行う必要はない。そこで、NOxの放出処理を行う場合には、ストイキまたはリッチ空燃比の運転域であっても排気ガス温度が比較的に低いエンジン1の運転状態の時には、排気ガスを触媒コンバータ30にNOx吸収時と同じ順流で流してNOx触媒31からNOxを放出・還元させるようにし、一方、ストイキまたはリッチ空燃比の運転域であって且つ排気ガス温度が上昇して高温になるエンジン1の運転状態(加速時や高負荷運転時など)のとき、即ち排気ガスの状態がSOx放出に有利なストイキまたはリッチ空燃比且つ高温になった時にのみ、排気切替弁20の弁体を逆流位置に切り替えて、触媒コンバータ30を流れる排気ガスの流れを逆流にし、SOxの放出処理を行うように制御してもよい。

【0076】また、ECU100によってNOx触媒31のSOx放出処理が必要か否かを判定し、SOx放出処理の必要なしと判定されたときには排気切替弁20の弁体を順流位置に保持して触媒コンバータ30を流れる排気ガスの流れを順流にし、必要があると判定されたときに排気切替弁20の弁体を逆流位置に切り替え、触媒コンバータ30を流れる排気ガスの流れを逆流にし、且つ、ECU100が、SOxの放出に最適な目標空燃比や目標触媒温度を算出し、さらに還元剤添加装置を備えた場合には目標還元剤量を算出し、これら目標値となるようにエンジン1や還元剤添加装置等を制御して、SOxの放出処理を行うようにしてもよい。

【0077】〔実施の形態3〕次に、本発明に係る内燃機関の排気浄化装置の第3の実施の形態について、図8

～図11を参照して説明する。

【0078】図8は、第3の実施の形態における内燃機関の排気浄化装置の概略構成を示す図である。同図に示す例では、排気通路に三元触媒が設けられていない点を除けば、先の第1及び第2の実施形態と基本的に同じである。

【0079】即ち、エンジン1は直列4気筒のリーンバークソリンエンジンであり、吸気管2及び吸気マニホールド3を介して各気筒に吸気が供給され、各気筒に連なる各吸気通路に燃料噴射弁7から燃料が噴射され、各気筒から排出される排気ガスは排気マニホールド8及び排気管9を介して排気され、吸気管2にはスロットルポジションセンサ5を備えたスロットル弁4とエアフロメータ6が設置され、排気管11には排気温センサ13が設置され、エンジン1には回転数センサ14が設置され、スロットルポジションセンサ5、エアフロメータ6、排気温センサ13、回転数センサ14の各出力信号がECU100に出力され、ECU100からの出力信号に基づいて燃料噴射弁7が作動制御される構成である。

【0080】また、排気管9は、4つのポートを備えた排気切替弁（流れ方向切替手段）20の第1ポートに接続されている。排気切替弁20の第2ポートは排気ガスを大気に排出する排気管（第2排気通路）10に接続され、排気切替弁20の第3ポートは排気管（第3排気通路）11を介して触媒コンバータ（排気浄化手段）30の入口30aに接続され、排気切替弁20の第4ポートは排気管（第4排気通路）12を介して触媒コンバータ（排気浄化手段）30の出口30bに接続されている。触媒コンバータ30には吸蔵還元型NOx触媒31が収容されている。

【0081】排気切替弁20は、その弁体を図8に示す順流位置（第1の位置）と図9に示す逆流位置（第2の位置）に切り替えることによって、触媒コンバータ30を流れる排気ガスの流れ方向を変えることができるバルブである。前記弁体が順流位置に位置しているとき、排気切替弁20は、排気管9と排気管11とを接続するとともに排気管10と排気管12とを接続し、この時、排気ガスは、排気管9→排気管11→触媒コンバータ30→排気管12→排気管10の順に流れて、大気に放出される。

【0082】また、排気切替弁20の弁体が図9に示す逆流位置に位置しているとき、排気切替弁20は、排気管9と排気管12とを接続するとともに排気管10と排気管11とを接続し、この時、排気ガスは、排気管9→排気管12→触媒コンバータ30→排気管11→排気管10の順に流れて、大気に放出される。

【0083】また、排気切替弁20の弁体が中立位置（図3参照）に位置しているとき、排気切替弁20は、排気管9と排気管10とを接続し、この時、排気ガス

は、排気管9→排気管10の順に流れて、大気に放出される。

【0084】触媒コンバータ30の排気通路への配置位置についても、排気ガスの流れが順流のときのNOx触媒床温度を確保するため、触媒コンバータ30の入口30aが排気切替弁20の近くに位置する配置としている。即ち、排気ガスが触媒コンバータ30に流入するまでの流路長さは、排気切替弁20の弁体を順流位置にしたときの方が、弁体を逆流位置にしたときよりも短い。そのため、排気ガスを排気管に流すと放熱現象により排気ガス温度が低下し、流路長さが長くなるほど温度降下は大きい。したがって、排気切替弁20の弁体を順流位置に位置させたときよりも、弁体を逆流位置に位置させたときの方が触媒コンバータ30に流入するまでの排気ガスの温度降下が大きい。

【0085】一方、図5に示すように、NOx触媒31のNOx浄化率は触媒温度と相関があり、NOxを吸収するのに最適な温度ウィンドウを有しており、このNOx吸収温度ウィンドウから外れるとNOx吸収能力が大幅に低下する。また、NOx触媒31からNOxを放出・還元させるときには、NOx触媒31の温度をそれほど高くしなくてもNOxを放出させることができる。

【0086】また、NOx触媒31の排気ガス浄化温度ウィンドウは、図10に示すように250℃～550℃程度であるが、高い浄化率が得られるのは400℃前後である。通常、このNOx触媒の床温度を制御するのに、触媒の温度が400℃付近になるように制御するようにしていたが、排気切替弁20の弁体を作動させると、弁体作動中に排気ガスがショートパスして触媒コンバータ30を一時的にバイパスするために、排気ガスが浄化されないで車外に排出される問題が生じる。

【0087】即ち、先の第1及び第2の実施の形態では、排気切替弁20を積極的に切り替える一方、排気ガスのバイパス時にエンジンの排気空燃比をストイキに制御する考え方を採用しているが、排気ガスがバイパスする問題を可能な限り少なくするためには、排気切替弁20の切替制御をできるだけ行わないようにすることも有効である。

【0088】そこで、この実施の形態では、NOx触媒31の温度が触媒活性温度内であれば、排気切替弁20の弁体を作動させず、触媒活性温度以上、あるいは触媒活性温度以下になったときに切替制御を行うようにした。この触媒活性温度については、触媒の種類によっても左右されるが、概ね250℃～550℃の範囲である。この温度範囲は、最高の活性が得られる400℃付近におけるNOx吸蔵能力（単位時間に吸収できるNOx量）の半分以下の能力とするのが好ましい。

【0089】図11は、このようにNOx触媒31の温度が触媒活性温度内であれば、排気切替弁20の弁体を作動させず、触媒活性温度以上、あるいは触媒活性温度

以下になったときに ECU 100 が排気切替弁 20 の弁体作動を実行する制御手順を示すフローチャートである。

【0090】まず、ステップ S 21 において、ECU 100 は NOx 触媒 31 の触媒床温度が 550℃ 以上か、又は 250℃ 以下かの判定を行う。ここで、触媒床温度が 550℃ 以上であることを判定した場合にはステップ S 22 に移行し、250℃ 以下であることを判定した場合には排気切替弁 20 の弁体位置を現状維持とし、リターンしてスタートへ戻る。

【0091】ステップ S 22 では、触媒床温度が 550℃ 以上か否かを判定し、550℃ 以上の場合はステップ S 23 へ移行し、550℃ 以下の場合はステップ S 25 へ移行する。ステップ S 23 では、排気切替弁 20 の弁体が順流位置（第 1 の位置）にあるか否かを判定し、順流位置にあるときはステップ S 24 へ移行し、排気切替弁 20 の弁体を逆流位置（第 2 の位置）へ切り替えた後リターンしてスタートへ戻る。排気ガスが逆流するときの方が排気通路の長さが長く温度降下が大きいため、触媒床温度を低下させることができる。ステップ S 23 において、排気切替弁 20 の弁体が逆流位置にあると判定した場合は、リターンしてスタートへ戻る。

【0092】一方、触媒床温度が 550℃ 以下であるときに移行するステップ S 25 では、排気切替弁 20 の弁体が順流位置にあるか否かを判定する。順流位置にあるときは現状維持とし、リターンしてスタートへ戻る。このステップ S 25 において、排気切替弁 20 の弁体が逆流位置にあることを判定した場合には、ステップ S 26 へ移行し、排気切替弁 20 の弁体を順流位置へ切り替える制御を実行した後、スタートへ戻る。

【0093】このように、第 3 の実施の形態によれば、NOx 触媒 31 の触媒活性温度内であれば、排気ガスの流れ方向を切り替える排気切替弁 20 の弁体は作動させず、その排気切替弁 20 の弁体を順流位置又は逆流位置の何れかに保持した状態とする。そして、触媒温度が触媒活性温度以上あるいは以下になったときに初めて流れ方向切替手段の切り替え制御を行う。これにより、排気浄化手段をバイパスする排気ガスの流れが存在する問題を、排気切替弁 20 の切り替え制御のみの簡便な方法で対処することができる。即ち、排気切替弁 20 をそもそも浄化率が低い触媒活性温度範囲外で切り替えるようにしているため、全体として排気浄化性能を向上させることができる。

【0094】

【発明の効果】本発明の第 1 の手段に係る内燃機関の排気浄化装置によれば、流れ方向切替手段の作動時に、排気浄化手段をバイパスする位置に流れ方向切替手段が切り替えられたときには、内燃機関の排気空燃比をストイキに制御することで、三元触媒を機能させ、排気ガスを浄化してから排出させることができる。したがって、

排気ガスの流れ方向切替手段の作動中に、排気浄化手段をバイパスする排気ガスの流れが生じたとしてもこれを浄化して排出することができる。

【0095】本発明の第 2 の手段に係る内燃機関の排気浄化装置によれば、三元触媒に SOx 吸収機能を持たせたものにおいては、内燃機関の排気空燃比がストイキ時に三元触媒より SOx が放出されるため、流れ方向切替手段の作動を排気バイパス位置で一時的に停止させ、SOx 放出が完了してから、流れ方向切替手段を切り替えるようにすることで、排気浄化手段の SOx 被毒を効果的に防止できる。

【0096】本発明の第 3 の手段に係る内燃機関の排気浄化装置によれば、排気浄化手段の触媒が触媒活性温度内であれば、排気ガスの流れ方向切替手段は作動させず、その切替手段を順流位置又は逆流位置の何れかに保持した状態とする。そして、触媒温度が触媒活性温度以上あるいは以下になったときに初めて流れ方向切替手段の切り替え制御を行うことで、排気浄化手段をバイパスする排気ガスの流れが存在する問題を、流れ方向切替手段の切り替え制御のみの簡便な方法で対処することができる。即ち、流れ方向切替手段をそもそも浄化率が低い触媒活性温度範囲外で切り替えるようにすることで、全体として排気浄化性能を向上させることができる。

【図面の簡単な説明】

【図 1】本発明に係る内燃機関の排気浄化装置の第 1 の実施の形態における概略構成図であり、排気切替弁を順流位置に位置させたときを示す図である。

【図 2】第 1 の実施の形態の排気浄化装置において、排気切替弁を逆流位置に位置させたときの要部を示す図である。

【図 3】第 1 の実施の形態の排気浄化装置において、排気切替弁を中立位置に位置させたときの要部を示す図である。

【図 4】吸蔵還元型 NOx 触媒の NOx 吸放出・還元作用を説明する図である。

【図 5】吸蔵還元型 NOx 触媒の NOx 浄化率の温度特性を示す図である。

【図 6】第 1 の実施の形態の排気浄化装置における制御手順を示すフローチャートである。

【図 7】本発明に係る内燃機関の排気浄化装置の第 2 の実施の形態における制御手順を示すフローチャートである。

【図 8】本発明に係る内燃機関の排気浄化装置の第 3 の実施の形態における概略構成図であり、排気切替弁を順流位置に位置させたときを示す図である。

【図 9】第 2 の実施の形態の排気浄化装置において、排気切替弁を逆流位置に位置させたときの要部を示す図である。

【図 10】吸蔵還元型 NOx 触媒の NOx 浄化率の温度特性に基づく触媒活性温度範囲を示す図である。

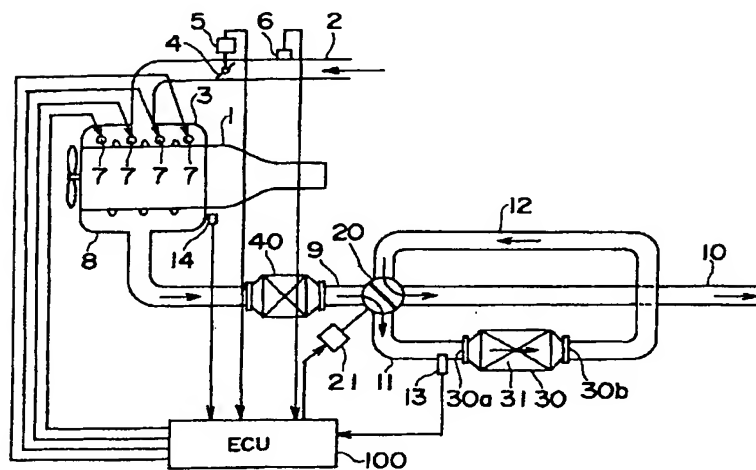
【図11】本発明に係る内燃機関の排気浄化装置の第3の実施の形態における制御手順を示すフローチャートである。

【符号の説明】

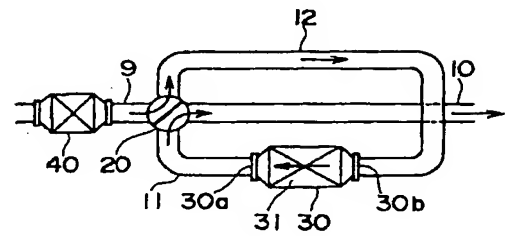
- 1 リーンバーンガソリンエンジン（内燃機関）
- 2 吸気管（吸気通路）
- 6 エアフロメータ
- 7 燃料噴射弁
- 9 排気管
- 10 排気管
- 11 排気管

- 12 排気管
- 13 排気温度センサ
- 14 回転数センサ
- 20 排気切替弁（流れ方向切替手段）
- 21 アクチュエータ（制御手段）
- 30 触媒コンバータ
- 31 NO_x触媒（SO_x吸収剤）
- 30a 入口
- 30b 出口
- 40 三元触媒
- 100 ECU（制御手段）

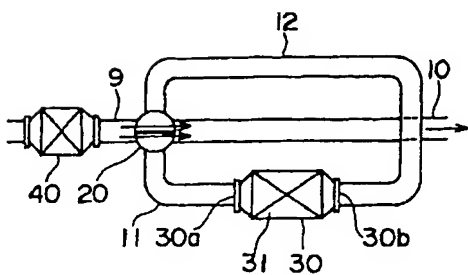
【図1】



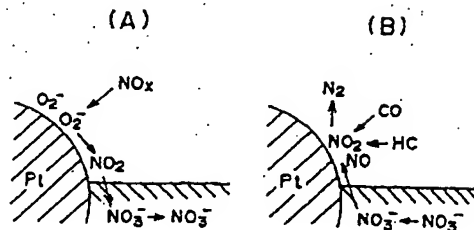
【図2】



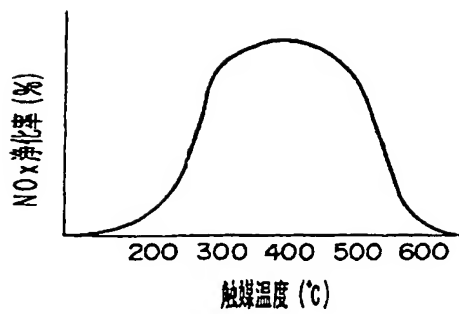
【図3】



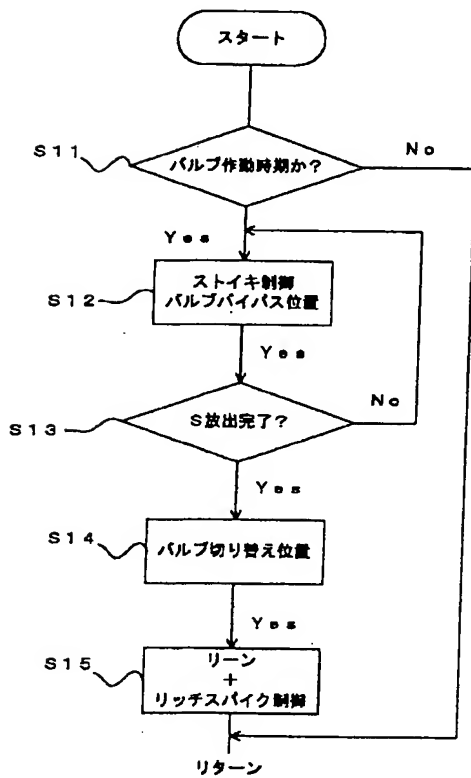
【図4】



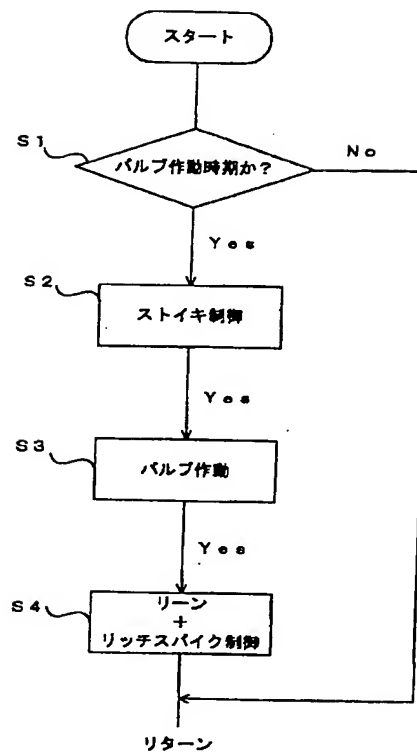
【図5】



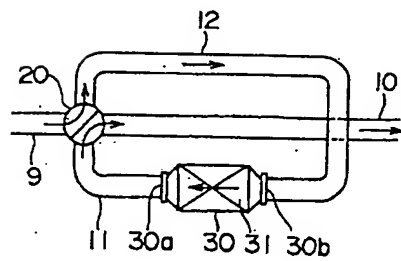
【図7】



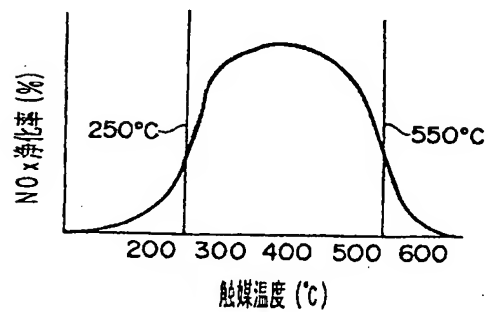
【図6】



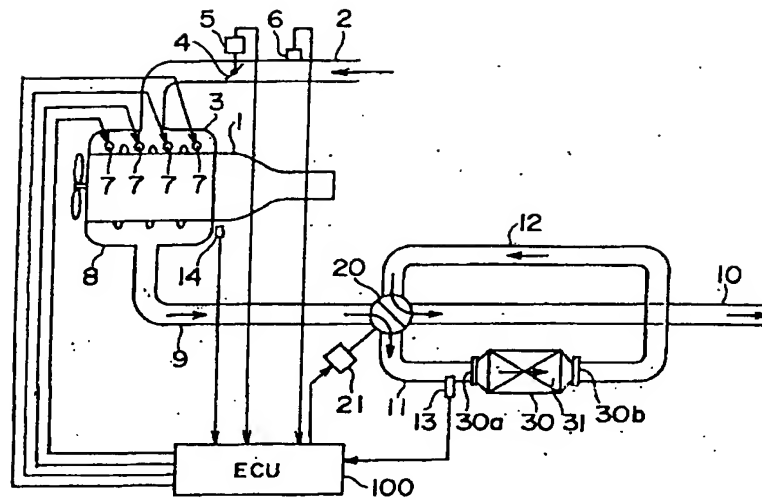
【図9】



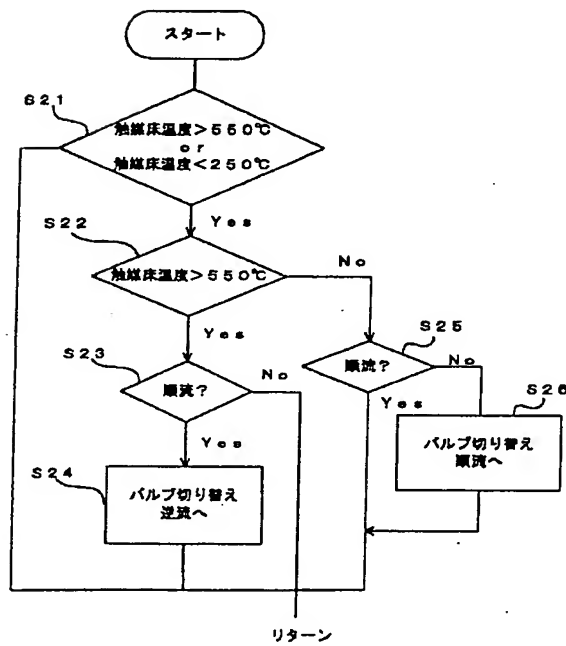
【図10】



【図8】



【図11】



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GB01X GB02W GB03W GB04W
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HA08 HA18 HA36 HA37 HB02
HB03
3G301 HA01 HA06 HA15 JA15 JA25
JA26 JA33 JB09 LA01 LB02
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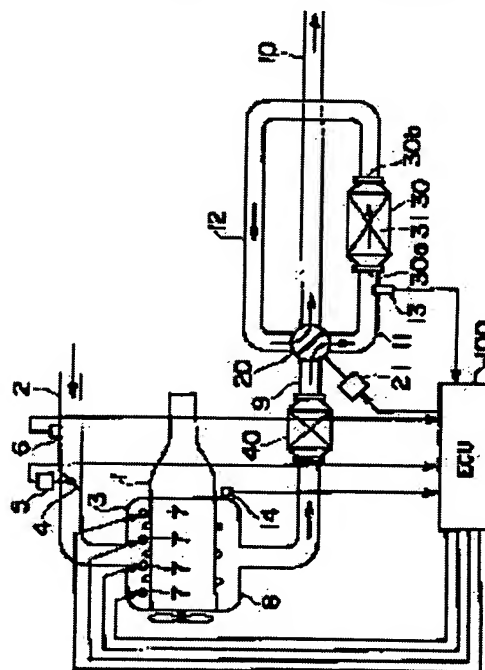
(72)Inventor : HIROTA SHINYA

(54) EXHAUST EMISSION CONTROL DEVICE FOR INTERNAL COMBUSTION ENGINE

(57)Abstract:

PROBLEM TO BE SOLVED: To purify and discharge an exhaust gas flow bypassing an exhaust emission control means even if it occurs.

SOLUTION: In this purifying device, a flow direction switching means 20 comprising four ports mounted on an exhaust passage 9 upstream of an exhaust emission control means 30 can be switched to a first position to flow exhaust gas in a first direction to the exhaust emission control means 30, a second position to flow exhaust gas in a second direction opposite to the first direction, and a third position to flow exhaust gas bypassing the exhaust emission control means 30. In this case, the device comprises the exhaust passage different in distance from an internal combustion engine



1 to the exhaust emission control means 30 by having the flow direction switching means 20 positioned at the first and the second positions for having the flow direction switching means 20 operated by a catalyst temperature of the exhaust emission control means 30 to have a three way catalyst mounted on the exhaust passage 9. When the flow direction switching means 20 is operated from the first position to the second position, an air fuel ratio of exhaust gas the internal combustion engine 1 is controlled in stoichiometric method.

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CLAIMS

[Claim(s)]

[Claim 1] Have an exhaust air purification means in the flueway of an internal combustion engine, and the flow direction change means which equipped the upstream flueway with four ports rather than this exhaust air purification means is established. The 1st flueway connected to the internal combustion engine is connected to the 1st port of this flow direction change means. The 2nd flueway connected to the atmosphere is connected to the 2nd port, and the 3rd flueway connected to the one side of the aforementioned exhaust air purification means is connected to the 3rd port. The 4th flueway connected to the other side of the aforementioned exhaust air purification means is connected to the 4th port. the aforementioned flow direction change means The 1st position which connects the 2nd port of the above, and the 4th port of the above, and pours exhaust gas in the 1st direction for the aforementioned exhaust air purification means while connecting the 1st port of the above, and the 3rd port of the above, The 2nd position which connects the 2nd port of the above, and the 3rd port of the above, and pours exhaust gas in the 2nd direction contrary to the 1st direction for the aforementioned exhaust air purification means while connecting the 1st port of the above, and the 4th port of the above, It is an exhaust emission control device switchable in the 3rd position which connects the 1st port of the above, and the 2nd port of the above, bypasses the aforementioned exhaust air purification means, and pours exhaust gas. In that to which it has the flueway where the distance from an internal combustion engine to an exhaust air purification means differs because the aforementioned flow direction change means takes the 1st position of the above, and the 2nd position, and the aforementioned flow direction change means operates with the degree of catalyst temperature of the aforementioned exhaust air purification means The exhaust emission control device of the internal combustion engine characterized by the exhaust air air-fuel ratio of an internal combustion engine being controlled by SUTOIKI when a three way component catalyst is prepared in the aforementioned flueway and the aforementioned flow direction change means operates from the 1st position of the above to the 2nd position of the above.

[Claim 2] The aforementioned three way component catalyst is the exhaust emission control device of the internal combustion engine according to claim 1 characterized by to change to the 2nd position after controlling the exhaust-air air-fuel ratio of an internal combustion engine to SUTOIKI and operating the aforementioned flow-direction change means in the 3rd position of the above, when it has the SOx absorption function to which the exhaust-air air-fuel ratio of the aforementioned internal combustion engine absorbs SOx by RIN and the aforementioned flow-direction change means operates from the 1st position of the above to the 2nd position of the above.

[Claim 3] Have an exhaust air purification means in the flueway of an internal combustion engine, and the flow direction change means which equipped the upstream flueway with four ports rather than this exhaust air purification means is established. The 1st flueway connected to the internal combustion engine is connected to the 1st port of this flow direction change means. The 2nd flueway connected to the atmosphere is connected to the 2nd port, and the 3rd flueway connected to the one side of the aforementioned exhaust air purification means is connected to the 3rd port. The 4th flueway connected to the other side of the aforementioned exhaust air purification means is connected to the 4th port. the

aforementioned flow direction change means The 1st position which connects the 2nd port of the above, and the 4th port of the above, and pours exhaust gas in the 1st direction for the aforementioned exhaust air purification means while connecting the 1st port of the above, and the 3rd port of the above, The 2nd position which connects the 2nd port of the above, and the 3rd port of the above, and pours exhaust gas in the 2nd direction contrary to the 1st direction for the aforementioned exhaust air purification means while connecting the 1st port of the above, and the 4th port of the above, It is an exhaust emission control device switchable in the 3rd position which connects the 1st port of the above, and the 2nd port of the above, bypasses the aforementioned exhaust air purification means, and pours exhaust gas. In that to which it has the flueway where the distance from an internal combustion engine to an exhaust air purification means differs by taking the 1st position and 2nd position of the aforementioned flow direction change means, and the aforementioned flow direction change means operates with the degree of catalyst temperature of the aforementioned exhaust air purification means The exhaust emission control device of the internal combustion engine characterized by forbidding the operation of the aforementioned flow direction change means when an exhaust air purification means is in the temperature window where the rate of exhaust air purification is high.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] Especially this invention relates to the exhaust emission control device of the internal combustion engine which can change the flow direction of the exhaust gas which flows an exhaust air purification means if needed about the exhaust emission control device of an internal combustion engine.

[0002]

[Description of the Prior Art] In order to purify the exhaust gas discharged from an internal combustion engine, generally an exhaust emission control device is installed in the flueway of an internal combustion engine. If the exhaust gas of an internal combustion engine is poured to this exhaust emission control device, a sediment will adhere gradually from the upstream in an exhaust emission control device. What this sediment is changes with composition of exhaust gas, or mechanisms of the composition of an exhaust emission control device, and exhaust air purification, for example, it has an oxide, a sulfide, a nitrate, a sulfate, etc. This sediment needs to reduce the purification performance of an exhaust emission control device, or may cause increase of an exhaust back pressure and needs to remove it to predetermined timing.

[0003] For example, there is an occlusion reduction-type NOx catalyst as an exhaust emission control device which purifies NOx of the exhaust gas discharged from the internal combustion engine which burns a RIN air-fuel ratio. This occlusion reduction-type NOx catalyst absorbs NOx, when the air-fuel ratio of inflow exhaust gas is RIN. Emit NOx absorbed when the oxygen density in inflow exhaust gas fell, and are the catalyst which returns to N2 and an occlusion reduction-type NOx catalyst is arranged to a flueway. By making rich the air-fuel ratio of the exhaust gas which nitrogen oxide (NOx) is made to absorb from the exhaust gas of a RIN air-fuel ratio, and increase in quantity etc. carries out fuel supplied to an internal combustion engine after NOx absorption, and flows into the aforementioned occlusion reduction-type NOx catalyst NOx emitted while making NOx absorbed from the aforementioned occlusion reduction-type NOx catalyst emit -- unburnt [in exhaust gas] -- reduction purification is carried out by reduction components, such as HC and CO, N2

[0004] By the way, if the sulfur content is contained in the fuel for an internal combustion engine and fuel is generally burned with an internal combustion engine, the sulfur content in fuel will burn and a sulfur oxide (SOx) will occur. Since the aforementioned occlusion reduction-type NOx catalyst absorbs SOx in exhaust gas by the same mechanism as performing the absorption of NOx, if an occlusion reduction-type NOx catalyst is arranged to the flueway of an internal combustion engine, not only NOx but SOx will be absorbed by the occlusion reduction-type NOx catalyst.

[0005] However, SOx absorbed by the occlusion reduction-type NOx catalyst is easy to tend be accumulated in an occlusion reduction-type NOx catalyst that it decomposes and is hard to be emitted on the conditions which perform discharge of NOx from an occlusion reduction-type NOx catalyst, and reduction purification (henceforth NOx discharge / reduction processing) in order to form a stable sulfate with time progress. Increase of the SOx accumulated dose within an occlusion reduction-type

NOx catalyst produces the so-called SOx poisoning to which the NOx absorption capacity of an occlusion reduction-type NOx catalyst decreases, it becomes impossible to fully remove NOx in exhaust gas, and NOx purification efficiency falls. Then, in order to continue at a long period of time and to maintain highly the NOx decontamination capacity of an occlusion reduction-type NOx catalyst, it is necessary to make SOx absorbed by the catalyst emit to proper timing.

[0006] In order to make SOx absorbed by the occlusion reduction-type NOx catalyst emit, it turns out that it is necessary make rich the air-fuel ratio of inflow exhaust gas, and to make an occlusion reduction-type NOx catalyst into an elevated temperature rather than the time of NOx discharge / reduction processing.

[0007] By the way, the distribution of the absorbed dose of SOx within an occlusion reduction-type NOx catalyst It has increased, so that it is close to the entrance side of exhaust gas in an occlusion reduction-type NOx catalyst. The sake, In case SOx absorbed by the occlusion reduction-type NOx catalyst is made to emit, by having passed in the same direction as the flow direction of the exhaust gas at the time of NOx absorption, the exhaust gas of a rich air-fuel ratio Even if SOx absorbed by the aforementioned entrance side in the occlusion reduction-type NOx catalyst is emitted There is a problem that a resorption will be carried out to an occlusion reduction-type NOx catalyst, and it cannot discharge efficiently from an occlusion reduction-type NOx catalyst only by emitted SOx moving the inside of an occlusion reduction-type NOx catalyst to the outlet side of exhaust gas.

[0008] Then, when making SOx absorbed by the occlusion reduction-type NOx catalyst emit as indicated by JP,7-259542,A, the technology of pouring the exhaust gas of a rich air-fuel ratio for an occlusion reduction-type NOx catalyst with the time of NOx absorption at an opposite direction is proposed. Thus, if it has the adverse current function which makes the flow of exhaust gas reverse and emits SOx, since the travel within an occlusion reduction-type NOx catalyst comes to be immediately discharged besides an occlusion reduction-type NOx catalyst few, SOx emitted from the occlusion reduction-type NOx catalyst can prevent that the resorption of the emitted SOx is carried out to an occlusion reduction-type NOx catalyst.

[0009] In the case of the exhaust emission control device of the internal combustion engine with an adverse current function currently indicated by the aforementioned official report Prepare the bypass path which makes an occlusion reduction-type NOx catalyst bypass, and a passage selector valve is prepared in the unification portion of the flueway and the aforementioned bypass path which stand in a row for an occlusion reduction-type NOx catalyst, respectively. Furthermore, between an occlusion reduction-type NOx catalyst and the aforementioned passage selector valves of the side near [this] an internal combustion engine is connected to the suction mouth of an exhaust air pump. When connecting the delivery of an exhaust air pump to a bypass path and making SOx emit from an occlusion reduction-type NOx catalyst While changing the valve position of the two aforementioned passage selector valves so that the whole quantity of exhaust air of an internal combustion engine may flow to a bypass path, with the time of the usual NOx absorption, the flow of the exhaust air which flows an occlusion reduction-type NOx catalyst to an opposite direction is generated by operating an exhaust air pump.

[0010]

[Problem(s) to be Solved by the Invention] In the exhaust emission control device of this conventional internal combustion engine with an adverse current function, an exhaust air pump and two or more passage selector valves were required, and part mark increased and it became a cost rise. Moreover, if part mark increase, time and effort will become this thing to maintenance check so much.

[0011] Moreover, although it is the art which perceived that the SOx discharge processing accompanied by an adverse current avoided the resorption of SOx by shortening the travel of SOx in the case of SOx discharge in the occlusion reduction-type NOx catalyst mentioned above If this art is adopted, since distance until exhaust gas results in an occlusion reduction-type NOx catalyst will become long on the other hand, The temperature fall of exhaust gas while circulating the long path is large, and may necessarily be unable to tell the best method to SOx discharge, considering the viewpoint of the temperature conditions at the time of SOx discharge.

[0012] Then, these people already proposed the technology which makes easy structure the exhaust

emission control device of such an internal combustion engine with an adverse current function, lessens part mark, and enabled it to aim at a cost cut (Japanese Patent Application No. 11-011025).

[0013] This technology has an exhaust air purification means in the flueway of an internal combustion engine, and the flow direction change means which equipped the upstream flueway with four ports rather than this exhaust air purification means is established. The 1st flueway connected to the internal combustion engine is connected to the 1st port of this flow direction change means. Connect to the 2nd port the 2nd flueway connected to the atmosphere, and the 3rd flueway connected to the one side of an exhaust air purification means is connected to the 3rd port. The 4th flueway connected to the other side of an exhaust air purification means is connected to the 4th port. a flow direction change means The 1st position which connects the 2nd port and the 4th port and pours exhaust gas in the 1st direction for an exhaust air purification means while connecting the 1st port and the 3rd port, While connecting the 1st port and the 4th port, it constitutes switchable in the 2nd position which connects the 2nd port and the 3rd port and pours exhaust gas in the 2nd direction contrary to the 1st direction for an exhaust air purification means.

[0014] In this exhaust emission control device, the length of a flueway with the 2nd direction where the 1st direction which pours exhaust gas and its 1st direction are reverse is changed so that the degree control of floor temperature of a catalyst with a temperature window can be performed using the length of an exhaust pipe. Namely, a temperature reduction is so large that exhaust gas temperature will fall according to a thermolysis phenomenon and the length of a flueway will become long, if exhaust gas is poured to an exhaust pipe. On the other hand, the rate of NOx purification of the NOx catalyst used for an exhaust air purification means has the degree of catalyst temperature, and correlation, and it has the optimal temperature window which absorbs NOx, and if it separates from this NOx absorption temperature window, NOx absorptance will decline sharply. Therefore, absorption and discharge control of NOx, discharge control of SOx, etc. can be efficiently performed by changing the flow direction of exhaust gas by the flow direction change means.

[0015] However, in this exhaust emission control device, in order to change the flow direction of exhaust gas, when the valve element of a flow direction change means was operated, as the flow of exhaust gas changed in the 2nd direction from the 1st direction, or the 1st direction from the direction of the 2nd, the problem by which the flow which bypasses an exhaust air purification means temporarily arises, and the exhaust gas which is not purified is discharged outside a vehicle had arisen.

[0016] Therefore, one of the technical problems which this invention tends to solve is to offer the exhaust emission control device of the internal combustion engine which can purify and discharge this during the operation of the flow direction change means of exhaust gas though the flow of the exhaust gas which bypasses an exhaust air purification means arises. Moreover, other one of the technical problems which this invention tends to solve is in change control of the flow direction change means of exhaust gas to offer the exhaust emission control device of the internal combustion engine which can control the flow of exhaust gas so that SOx poisoning of an exhaust air purification means does not arise. Moreover, one of the technical problems which this invention tends to solve of further others is to offer the exhaust emission control device of the internal combustion engine which it is made for the flow of the exhaust gas which bypasses an exhaust air purification means not to arise as much as possible, and can raise an exhaust air purification performance as a whole because the rate of purification changes a flow direction change means out of a low catalytic activity temperature requirement.

[0017]

[Means for Solving the Problem] this invention adopted the following meanses, in order to solve the aforementioned technical problem. The 1st means of this invention has an exhaust air purification means in the flueway of an internal combustion engine. The flow direction change means equipped with four ports is prepared in an upstream flueway rather than this exhaust air purification means. The 1st flueway connected to the internal combustion engine is connected to the 1st port of this flow direction change means. The 2nd flueway connected to the atmosphere is connected to the 2nd port, and the 3rd flueway connected to the one side of the aforementioned exhaust air purification means is connected to the 3rd port. The 4th flueway connected to the other side of the aforementioned exhaust air purification means is

connected to the 4th port. the aforementioned flow direction change means The 1st position which connects the 2nd port of the above, and the 4th port of the above, and pours exhaust gas in the 1st direction for the aforementioned exhaust air purification means while connecting the 1st port of the above, and the 3rd port of the above, The 2nd position which connects the 2nd port of the above, and the 3rd port of the above, and pours exhaust gas in the 2nd direction contrary to the 1st direction for the aforementioned exhaust air purification means while connecting the 1st port of the above, and the 4th port of the above, It is an exhaust emission control device switchable in the 3rd position which connects the 1st port of the above, and the 2nd port of the above, bypasses the aforementioned exhaust air purification means, and pours exhaust gas. In that to which it has the flueway where the distance from an internal combustion engine to an exhaust air purification means differs because the aforementioned flow direction change means takes the 1st position of the above, and the 2nd position, and the aforementioned flow direction change means operates with the degree of catalyst temperature of the aforementioned exhaust air purification means When a three way component catalyst is prepared in the aforementioned flueway and the aforementioned flow direction change means operates from the 1st position of the above to the 2nd position of the above, it is characterized by the exhaust air air-fuel ratio of an internal combustion engine being controlled by SUTOIKI.

[0018] In the exhaust emission control device of this internal combustion engine, by changing a flow direction change means and choosing either the 1st position or the 2nd position, exhaust gas can be poured for an exhaust air purification means at the forward direction, or can be poured to an opposite direction. At the time of the operation of a flow direction change means, when it changes to the 3rd position which bypasses an exhaust air purification means, a three way component catalyst functions by the exhaust air air-fuel ratio of an internal combustion engine being controlled by SUTOIKI, and exhaust gas is purified and discharged. Therefore, during the operation of the flow direction change means of exhaust gas, though the flow of the exhaust gas which bypasses an exhaust air purification means arises, this can be purified and discharged. About a three way component catalyst, it can prepare in any flueway of the upstream of an exhaust air purification means, or a downstream.

[0019] With the 2nd means of this invention, it is characterized by to change it to the 2nd position, after the aforementioned three way component catalyst controls the exhaust-air air-fuel ratio of an internal combustion engine to SUTOIKI and operates the aforementioned flow-direction change means in the 3rd position of the above, when it has the SOx absorption function to which the exhaust-air air-fuel ratio of the aforementioned internal combustion engine absorbs SOx by RIN and the aforementioned flow-direction change means operates from the 1st position of the above to the 2nd position of the above.

[0020] Thus, in what gave the SOx absorption function to the three way component catalyst, after the exhaust air air-fuel ratio of an internal combustion engine stops the operation of a flow direction change means temporarily in the 3rd position which is an exhaust air bypass position since SOx is emitted from a three way component catalyst at the time of SUTOIKI, and SOx discharge is completed, it is controlled to change a flow direction change means to the 2nd position. Thereby, SOx poisoning of an exhaust air purification means can be prevented effectively.

[0021] With the third means of this invention, it has an exhaust air purification means in the flueway of an internal combustion engine. The flow direction change means equipped with four ports is prepared in an upstream flueway rather than this exhaust air purification means. The 1st flueway connected to the internal combustion engine is connected to the 1st port of this flow direction change means. The 2nd flueway connected to the atmosphere is connected to the 2nd port, and the 3rd flueway connected to the one side of the aforementioned exhaust air purification means is connected to the 3rd port. The 4th flueway connected to the other side of the aforementioned exhaust air purification means is connected to the 4th port. the aforementioned flow direction change means The 1st position which connects the 2nd port of the above, and the 4th port of the above, and pours exhaust gas in the 1st direction for the aforementioned exhaust air purification means while connecting the 1st port of the above, and the 3rd port of the above, The 2nd position which connects the 2nd port of the above, and the 3rd port of the above, and pours exhaust gas in the 2nd direction contrary to the 1st direction for the aforementioned exhaust air purification means while connecting the 1st port of the above, and the 4th port of the above,

It is an exhaust emission control device switchable in the 3rd position which connects the 1st port of the above, and the 2nd port of the above, bypasses the aforementioned exhaust air purification means, and pours exhaust gas. In that to which it has the flueway where the distance from an internal combustion engine to an exhaust air purification means differs by taking the 1st position and 2nd position of the aforementioned flow direction change means, and the aforementioned flow direction change means operates with the degree of catalyst temperature of the aforementioned exhaust air purification means. When the degree of catalyst temperature of an exhaust air purification means is in the temperature window where the rate of exhaust air purification is high, it is characterized by forbidding the operation of the aforementioned selector valve.

[0022] Thus, by elaborating change control of the flow direction change means of exhaust gas, it is made for the flow of the exhaust gas which bypasses an exhaust air purification means not to arise as much as possible, and, thereby, it can purify exhaust gas efficiently with a necessary minimum exhaust air purification means. If it is in catalytic activity temperature when an exhaust air purification means is for example, a NO_x catalyst, the flow direction change means of exhaust gas will not be operated, and will be made into the state where the change means was held they to be [any of the 1st position or the 2nd position]. And when the degree of catalyst temperature becomes more than catalytic activity temperature (temperature window) or the following, change control of a flow direction change means is performed for the first time. It can be coped with by the simple method of only change control of the problem in which the flow of the exhaust gas which bypasses an exhaust air purification means exists by this of a flow direction change means. That is, since it is made for the rate of purification to change a flow direction change means out of a low catalytic activity temperature requirement primarily, an exhaust air purification performance improves as a whole.

[0023]

[Embodiments of the Invention] Hereafter, the gestalt of operation of the exhaust emission control device of the internal combustion engine concerning this invention is explained with reference to a drawing.

[Gestalt of the 1st operation] Drawing 1 is drawing showing the outline composition in the gestalt of operation at the time of applying the exhaust emission control device of the internal combustion engine concerning this invention to the gasoline engine (the so-called RIN barn gasoline engine) which can burn in a RIN air-fuel ratio.

[0024] In this drawing, an engine 1 is an in-series 4-cylinder, and inhalation of air is supplied to each cylinder through an inlet pipe 2 and an inlet manifold 3. The throttle valve 4 which is interlocked with the accelerator pedal which is not illustrated, and opens and closes the inhalation-of-air path in an inlet pipe 2 is formed in an inlet pipe 2, and the throttle position sensor 5 which outputs the output signal corresponding to the opening of a throttle valve 4 to the electronic control unit (ECU) 100 for engine control is attached in it at this throttle valve 4.

[0025] In the inlet pipe 2, the air flow meter 6 which outputs the output signal corresponding to the inhalation air content (inhalation air mass) Q which flows the inside of an inlet pipe 2 to ECU100 is attached in the upstream rather than the throttle valve 4.

[0026] Fuel (gasoline) is injected from a fuel injection valve 7 by each inhalation-of-air path which stands in a row in each cylinder of an engine 1. The valve-opening stage and valve-opening period of a fuel injection valve 7 are controlled by ECU100 according to the operational status of an engine 1.

[0027] The exhaust gas discharged from each cylinder of an engine 1 is exhausted through an exhaust manifold 8 and an exhaust pipe (the 1st flueway) 9. The three way component catalyst 40 is formed in the middle of the exhaust pipe 9. This three way component catalyst 40 has the function which purifies NO_x in exhaust gas, SO_x, HC, CO, etc., when the exhaust air air-fuel ratio of an engine 1 is SUTOIKI.

[0028] The exhaust pipe 9 is connected to the 1st port of the exhaust air selector valve (flow direction change means) 20 equipped with four ports. The 2nd port of the exhaust air selector valve 20 is connected to the exhaust pipe (the 2nd flueway) 10 which discharges exhaust gas to the atmosphere, the 3rd port of the exhaust air selector valve 20 is connected to entrance 30a of a catalytic converter (exhaust air purification means) 30 through an exhaust pipe (the 3rd flueway) 11, and the 4th port of the

exhaust air selector valve 20 is connected to outlet 30b of a catalytic converter (exhaust air purification means) 30 through the exhaust pipe (the 4th flueway) 12. The occlusion reduction-type NOx catalyst (it abbreviates to a NOx catalyst hereafter) 31 is held in the catalytic converter 30. The NOx catalyst 31 is explained in full detail later.

[0029] The exhaust air selector valve 20 is a bulb into which the flow direction of the exhaust gas which flows a catalytic converter 30 is changeable by changing to the adverse current position which shows the valve element to the forward-feed position shown in drawing 1 , and drawing 2 . When the aforementioned valve element is located in a forward-feed position, the exhaust air selector valve 20 connects an exhaust pipe 10 and an exhaust pipe 12 while connecting an exhaust pipe 9 and an exhaust pipe 11, and at this time, exhaust gas flows in order of the three-way-component-catalyst 40 -> exhaust pipe 9 -> exhaust pipe 11 -> catalytic-converter 30 -> exhaust pipe 12 -> exhaust pipe 10, and it is emitted to the atmosphere. Thus, the flow of the exhaust gas which flows toward outlet 30b from entrance 30a of a catalytic converter 30 is called a "forward feed" in the following explanation.

[0030] Moreover, when the valve element of the exhaust air selector valve 20 is located in the adverse current position shown in drawing 2 , the exhaust air selector valve 20 connects an exhaust pipe 10 and an exhaust pipe 11 while connecting an exhaust pipe 9 and an exhaust pipe 12, and at this time, exhaust gas flows in order of the three-way-component-catalyst 40 -> exhaust pipe 9 -> exhaust pipe 12 -> catalytic-converter 30 -> exhaust pipe 11 -> exhaust pipe 10, and it is emitted to the atmosphere. Thus, the flow of the exhaust gas which flows toward entrance 30a from outlet 30b of a catalytic converter 30 is called "an adverse current" in the following explanation.

[0031] Moreover, when the valve element of the exhaust air selector valve 20 is located in the center valve position shown in drawing 3 , the exhaust air selector valve 20 connects an exhaust pipe 9 and an exhaust pipe 10, and at this time, exhaust gas flows in order of the three-way-component-catalyst 40 -> exhaust pipe 9 -> exhaust pipe 10, and it is emitted to the atmosphere. Thus, ***** of the exhaust gas which bypasses a catalytic converter 30, without flowing is called a "short pass" by the following explanation.

[0032] This exhaust air selector valve 20 is driven to an actuator 21, the change of a valve element position is performed, and an actuator 21 is controlled by ECU100. An actuator 21 and ECU100 constitute control means from a gestalt of this operation. Change control of the valve element position of the exhaust air selector valve 20 is explained in full detail later.

[0033] The exhaust gas temperature sensor 13 which outputs the output signal corresponding to the temperature of the exhaust gas which flows the inside of an exhaust pipe 11 near the entrance 30a of a catalytic converter 30 in an exhaust pipe 11 to ECU100 is attached.

[0034] ECU100 consists of a digital computer, possesses ROM (lead-on memory), RAM (RAM), CPU (central processor unit), the input port, and the output port which were mutually connected by the bi-directional bus, and performs basic control, such as AFC of an engine 1, and also it is performing SOx discharge processing control of a catalytic converter 30 etc. with the gestalt of this operation.

[0035] For these control, the input signal from the aforementioned air flow meter 6 and the input signal from an exhaust gas temperature sensor 13 are inputted, and also the input signal from the rotational frequency sensor 14 is inputted into the input port of ECU100. The rotational frequency sensor 14 outputs the output signal according to the rotational frequency of an engine 1 to ECU100, and ECU100 calculates engine-speed N from this output signal. Moreover, ECU100 calculates the inhalation air content Q from the output signal of an air flow meter 6, and calculates engine load Q/N (inhalation air-content Q / engine-speed N). And ECU100 judges the operational status of an engine 1 from engine-speed N and engine load Q/N, controls the fuel quantity injected from a fuel injection valve according to the operational status, and performs AFC changed to a RIN air-fuel ratio, SUTOIKI, or a rich air-fuel ratio. If an example of this AFC is given, in the time of a warm-up, and a heavy load operation region, it considers as SUTOIKI or a rich air-fuel ratio, and there is the control method made into a RIN air-fuel ratio in a low Naka load operation region.

[0036] The NOx catalyst 31 held in the catalytic converter 30, i.e., an occlusion reduction-type NOx catalyst, makes an alumina support, and at least one chosen from an alkaline earth like Potassium K,

Sodium Na, Lithium Li, alkali metal like Caesium Cs, Barium Ba, and Calcium calcium, Lanthanum La, and rare earth like Yttrium Y and noble metals like Platinum Pt are supported on this support.

[0037] This NOx catalyst 31 emits NOx absorbed when the air-fuel ratio (an exhaust air air-fuel ratio is called hereafter) of inflow exhaust gas was RIN, NOx was absorbed and the oxygen density in inflow exhaust gas fell, and is N2. It returns. In addition, an exhaust air air-fuel ratio shall mean the ratio of the sum total of an air content, and the sum total of fuel (hydrocarbon) supplied to the flueway of the upstream of the NOx catalyst 31, an engine combustion chamber, an inhalation-of-air path, etc. here, respectively. Therefore, when fuel, a reducing agent, or air is not supplied in the flueway of the NOx catalyst 31 upstream, an exhaust air air-fuel ratio will be in agreement with the air-fuel ratio of the gaseous mixture supplied to an engine combustion chamber.

[0038] The so-called RIN barn gasoline engine in which combustion with a RIN air-fuel ratio is possible is used as an internal combustion engine, and the air-fuel ratio of a gaseous mixture is controlled by the gestalt of this operation according to the operational status of an engine 1. So, when the engine 1 is operated with the RIN air-fuel ratio, an exhaust air air-fuel ratio becomes RIN, and an oxygen density becomes high. the time of on the other hand the engine 1 being operated with SUTOIKI or the rich air-fuel ratio -- an exhaust air air-fuel ratio -- SUTOIKI or unburnt [which is discharged from an engine 1 while becoming rich and the oxygen density in exhaust gas falling sharply] -- components, such as HC and CO, increase

[0039] Although there is also a portion which is not clear about the mechanism of the NOx absorption/emission action of the NOx catalyst 31, it is thought that it is carried out by the mechanism as shown in drawing 4 . Although this mechanism is explained taking the case of the case where Platinum Pt and Barium Ba are made to support, on support, it becomes the same mechanism even if it uses other noble metals, alkali metal, an alkaline earth, and rare earth.

[0040] First, since the oxygen density in inflow exhaust gas will increase sharply if inflow exhaust gas becomes remarkable RIN, as it is shown in drawing 4 (A), it is oxygen O2. It adheres to the front face of Platinum Pt in the form of O2- or O2-. Next, NO contained in exhaust gas reacts with O2- or O2- on the front face of Platinum Pt, and is NO2. It becomes ($2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$).

[0041] Then, oxidizing on Platinum Pt, unless the NOx absorptance of the NOx catalyst 31 is saturated, generated NO2 is absorbed in the NOx catalyst 31, combines with a barium oxide BaO, and as shown in drawing 4 (A), it is diffused in the NOx catalyst 31 in the form of nitrate-ion NO3-. Thus, NOx is absorbed in the NOx catalyst 31.

[0042] On the other hand, when the oxygen density in inflow exhaust gas falls, the amount of generation of NO2 falls and nitrate-ion NO3- within the NOx catalyst 31 is emitted by the reaction ($\text{NO}_3^- \rightarrow \text{NO}_2$) contrary to the aforementioned reaction from the NOx catalyst 31 in the form of NO2 or NO.

[0043] On the other hand, if reduction components, such as HC and CO, exist in inflow exhaust gas, these components will react with oxygen O2- on Platinum Pt, or O2-, will oxidize, will consume the oxygen in exhaust gas, and will reduce the oxygen density in exhaust gas. Moreover, NO2 emitted from the NOx catalyst 31 by the oxygen density fall in exhaust gas Or it reacts with HC and CO and NO is returned, as shown in drawing 4 (B). Thus, NO2 on Platinum Pt Or if NO stops existing, NO2 or NO will be emitted to a degree from a degree from the NOx catalyst 31.

[0044] That is, HC in inflow exhaust gas and CO react immediately with oxygen O2- on Platinum Pt, or O2- first, and are made to oxidize, and if HC and CO still remain even if oxygen O2- or O2- on Platinum Pt is subsequently consumed, NOx discharged from NOx and the engine which were emitted from the NOx catalyst 31 will be made to return them to N2 by this HC and CO.

[0045] thus, if an exhaust air air-fuel ratio becomes RIN, NOx will absorb for the NOx catalyst 31 -- having -- an exhaust air air-fuel ratio -- SUTOIKI -- or if it is made rich, NOx will be emitted to the inside of a short time from the NOx catalyst 31, and will be returned to N2 Therefore, eccrisis of NOx to the inside of the atmosphere can be prevented.

[0046] Next, the mechanism of SOx poisoning of the NOx catalyst 31 is explained. If the sulfur oxide (SOx) is contained in exhaust gas, the NOx catalyst 31 will absorb SOx in exhaust gas by the same mechanism as absorption of above-mentioned NOx. That is, when an exhaust air air-fuel ratio is RIN,

oxygen O₂ has adhered to the front face of the platinum Pt of the NO_x catalyst 31 in the form of O₂- or O₂-, and SO_x in inflow exhaust gas (for example, SO₂) oxidizes on the front face of Platinum Pt, and serves as SO₃.

[0047] Then, generated SO₂ is absorbed in the NO_x catalyst 31, combines with a barium oxide BaO, oxidizing further on the front face of Platinum Pt, is diffused in the NO_x catalyst 31 in the form of sulfate-ion SO₄²⁻, and forms a sulfate BaSO₄. Since a crystal tends to turn big and rough and tends [comparatively] to be stabilized, once it is generated, the decomposition discharge of BaSO₄ will be hard to be carried out. For this reason, if the amount of generation of BaSO₄ in the NO_x catalyst 31 increases with the passage of time, the amount of BaO which can participate in absorption of the NO_x catalyst 31 will decrease, and the absorptance of NO_x will decline. It is this, i.e., SO_x poisoning. Therefore, in order to maintain the NO_x absorptance of the NO_x catalyst 31 highly, it is necessary to make SO_x absorbed by the NO_x catalyst 31 to proper timing emit.

[0048] In order to make SO_x emit from the NO_x catalyst 31, it turns out that it turns out that what is necessary is just to reduce the oxygen density of exhaust gas like the case where NO_x is made to emit, and it is easy to emit, so that the temperature of the NO_x catalyst 31 is high.

[0049] In order to have made SO_x absorbed by the NO_x catalyst 31 emit by research of these people, as for the time of SUTOIKI or the usual NO_x discharge / reduction processing to which carry out richly and NO_x is made to emit from the NO_x catalyst 31, the temperature of the NO_x catalyst 31 showed [the inflow exhaust air air-fuel ratio] that it was necessary to make it high.

[0050] Moreover, the absorbing state of SO_x in a catalytic converter 30 Since the SO_x absorbed dose increases more than the NO_x catalyst 31 to which the direction of the NO_x catalyst 31 which is carrying out the position soon is located in entrance 30a of a catalytic converter 30 in the distance from entrance 30a, If an exhaust air air-fuel ratio turns SUTOIKI or rich and hot exhaust gas to the entrance 30a side and pours it from the outlet 30b side of a catalytic converter 30 in case SO_x is made to emit from the NO_x catalyst 31, SO_x can be emitted in a short time.

[0051] About the arrangement position to the flueway of a catalytic converter 30, in order to secure the degree of NO_x catalyst floor temperature in case the flow of exhaust gas is a forward feed, entrance 30a of a catalytic converter 30 is considering as the arrangement located near the exhaust air selector valve 20. That is, passage length until exhaust gas flows into a catalytic converter 30 has a direction shorter than the time of making a valve element into an adverse current position when making the valve element of the exhaust air selector valve 20 into a forward-feed position so that drawing 1 which shows the state where the valve element of the exhaust air selector valve 20 was located in the forward-feed position, and drawing 2 which shows the state where the valve element of the exhaust air selector valve 20 was located in the adverse current position may show. Therefore, a temperature reduction is so large that exhaust gas temperature will fall according to a thermolysis phenomenon and passage length will become long, if exhaust gas is poured to an exhaust pipe. Therefore, the temperature reduction of exhaust gas until the direction when locating a valve element in an adverse current position flows into a catalytic converter 30 is larger than the time of locating the valve element of the exhaust air selector valve 20 in a forward-feed position.

[0052] On the other hand, as shown in drawing 5, the rate of NO_x purification of the NO_x catalyst 31 has the degree of catalyst temperature, and correlation, and it has the optimal temperature window (henceforth a NO_x absorption window) for absorbing NO_x, and if it separates from this NO_x absorption window, NO_x absorptance will decline sharply. Moreover, when making NO_x emit and return from the NO_x catalyst 31, even if it does not make temperature of the NO_x catalyst 31 so high, when making SO_x emit from the NO_x catalyst 31 of the thing to which NO_x can be made to emit, the direction which made temperature of the NO_x catalyst 31 the elevated temperature as mentioned above can emit SO_x efficiently.

[0053] On the other hand, in order to carry out a short pass and to bypass a catalytic converter 30 as exhaust gas shows during a valve element operation at drawing 3 if the valve element of the exhaust air selector valve 20 is operated, the exhaust gas is not purified by the three way component catalyst as an exhaust air air-fuel ratio is RIN.

[0054] Then, with the gestalt of this operation, we decided to control an exhaust air air-fuel ratio to SUTOIKI in the valve element position (the 3rd position) as for which exhaust gas carries out a short pass during the valve element operation based on change operation of the required exhaust air selector valve 20 in case the flow direction of exhaust gas is considered as a forward feed or an adverse current. About change operation of the exhaust air selector valve 20 accompanied by the operation of this valve element For example, when making the flow of the exhaust gas in a catalytic converter 30 into a forward feed at the time of absorption of NOx and SOx and making an adverse current the flow of the exhaust gas in a catalytic converter 30 at the time of discharge of NOxSOx, Or the time of changing the flow direction of exhaust gas to a forward feed or an adverse current in consideration of the point which the rate of NOx purification of the NOx catalyst 31 correlates with the degree of catalyst temperature, so that the degree of catalyst temperature may not separate from a temperature window etc. can be illustrated.

[0055] Next, the operation of the exhaust emission control device in the gestalt of this operation is explained taking the case of the control which makes exhaust gas flow backwards at the time of NOx or SOx discharge. As mentioned above, an engine 1 is a RIN barn gasoline engine. According to the operational status of an engine 1, an air-fuel ratio is controlled by ECU100. When the engine 1 is operated with the RIN air-fuel ratio, an exhaust air air-fuel ratio becomes RIN. the time of an oxygen density becoming high and the engine 1 being operated with SUTOIKI or the rich air-fuel ratio -- an exhaust air air-fuel ratio -- SUTOIKI or unburnt [which is discharged from an engine 1 while becoming rich and the oxygen density in exhaust gas falling sharply] -- components, such as HC and CO, increase

[0056] Then, when the engine 1 is operated with the RIN air-fuel ratio, the operation of an actuator 21 is controlled by ECU100 so that the valve element of the exhaust air selector valve 20 is held in the forward-feed position shown in drawing 1 . Thereby, the exhaust gas of an engine 1 flows in order of the three-way-component-catalyst 40 -> exhaust pipe 9 -> exhaust pipe 11 -> catalytic-converter 30 -> exhaust pipe 12 -> exhaust pipe 10, comes to be emitted to the atmosphere, and serves as a forward feed which flows toward outlet 30b from entrance 30a in a catalytic converter 30. At this time, NOx and SOx in exhaust gas are absorbed by the NOx catalyst 31 of a catalytic converter 30. Moreover, at this time, since an exhaust air air-fuel ratio is RIN, a three way component catalyst 40 hardly functions.

[0057] And when the engine 1 is operated with SUTOIKI or the rich air-fuel ratio, the operation of an actuator 21 is controlled by ECU100 so that the valve element of the exhaust air selector valve 20 is held in the adverse current position shown in drawing 2 . Thereby, the exhaust gas of an engine 1 flows in order of the three-way-component-catalyst 40 -> exhaust pipe 9 -> exhaust pipe 12 -> catalytic-converter 30 -> exhaust pipe 11 -> exhaust pipe 10, comes to be emitted to the atmosphere, and serves as an adverse current which flows toward entrance 30a from outlet 30b in a catalytic converter 30. Moreover, while operating the engine 1 with SUTOIKI or the rich air-fuel ratio, the operation control of an engine 1 is made by ECU100 so that it may become the exhaust gas temperature to which SOx is easy to be emitted from the NOx catalyst 31.

[0058] thereby, the hot exhaust gas of SUTOIKI or a rich air-fuel ratio comes to pass through the inside of a catalytic converter 30 in NOx and the direction contrary to the time of SOx absorption, and NOx emits from the NOx catalyst 31 -- having -- further -- unburnt [in exhaust gas] -- reduction purification is carried out by HC, CO, etc. N2 Moreover, SOx absorbed by the NOx catalyst 31 can be made to emit to the inside of a short time from the NOx catalyst 31, when exhaust gas flows backwards a catalytic converter 30.

[0059] Moreover, when RIN air-fuel ratio operation continues by the service condition of an engine 1 for a long time, an engine 1 is controlled to be compulsorily operated with SUTOIKI or a rich air-fuel ratio, discharge processing of NOxSOx is performed as mentioned above, and it is made for a catalytic converter 30 to be saturated neither with NOx nor SOx. The AFC method of such an engine 1 is called RIN rich spike control by the following explanation. In addition, if a numeric value is concretely mentioned and explained about RIN rich spike control, when "RIN air-fuel ratio operation" of an engine 1 will continue for dozens seconds (for example, 40 - 60 seconds), "SUTOIKI or rich air-fuel ratio

operation" is condition that continue several seconds (for example, 2 - 3 seconds), and this "RIN air-fuel ratio operation", and "SUTOIKI or rich air-fuel ratio operation" is performed by turns.

[0060] thus, the valve element of the exhaust air selector valve 20 -- the adverse current position from a forward-feed position -- or it changes from an adverse current position to a forward-feed position -- on the way -- coming out -- as shown in drawing 3, exhaust gas carries out a short pass from an exhaust pipe 9 to an exhaust pipe 10, and bypasses a catalytic converter 30. At this time, a three way component catalyst 40 does not function as the exhaust gas which carries out a short pass being RIN, and exhaust gas is not purified. Therefore, during the valve element operation of the exhaust air selector valve 20, an exhaust air air-fuel ratio is compulsorily controlled by the operation control of an engine 1 at SUTOIKI, and a three way component catalyst 40 is operated by it, and after a three way component catalyst 40 purifies the exhaust gas which carries out a short pass, it is made to emit to the atmosphere.

[0061] Drawing 6 is a flow chart which shows the control procedure which ECU100 performs when controlling an exhaust air air-fuel ratio to SUTOIKI compulsorily by the operation control of an engine 1 in this way. First, at Step S1, ECU100 judges whether it is a bulb operation stage. Although this judgment is determined [whether the flow direction of exhaust gas is changed, and] by the property of the whole exhaust air purification system or an exhaust air purification means when what conditions are fulfilled for example, when ECU100 integrates the operation time of an engine 1 and the integrated value reaches the specified quantity, judge with the SOx discharge processing need, or The amount of SOx(es) in which ECU100 was absorbed by the NOx catalyst 31 is integrated, and when integrated value reaches the specified quantity, it can illustrate judging with the SOx discharge need etc. Moreover, in the case of the RIN barn gasoline engine which can burn in a RIN air-fuel ratio, since the operational status of an engine changes to combustion by the RIN air-fuel ratio, and combustion by the rich air-fuel ratio, when carrying out change control of the operational status ***** exhaust air change-over valve 20 of this engine, it can illustrate.

[0062] In Step S1, if it judges that it is not a bulb operation stage, a return will be carried out and it will return to a start. When it is judged that it is a bulb operation stage, in Step S2, the exhaust air air-fuel ratio of an engine 1 is compulsorily controlled to SUTOIKI. If the exhaust air air-fuel ratio of an engine 1 is controlled to SUTOIKI, next in Step S3, the valve element (bulb) of the exhaust air selector valve 20 will be changed from a forward-feed position to an adverse current position by operation control of an actuator 21.

[0063] If change control of a bulb is completed, it will shift to step S4. ECU100 is controlled by step S4 to RIN rich spike operation etc. at the air-fuel ratio according to the operational status of an engine 1, or a compulsive target. The return of after shift is carried out to step S4, and it returns to a start.

[0064] In addition, it is same to control compulsorily the exhaust air air-fuel ratio of an engine 1 during a bulb operation at SUTOIKI when changing the flow direction of exhaust gas to a forward feed or an adverse current in consideration of the point which the rate of NOx purification of the NOx catalyst 31 correlates with the degree of catalyst temperature so that the degree of catalyst temperature may not separate from a temperature window.

[0065] With the gestalt of this operation, the direction where exhaust gas flows to a forward feed turns into the 1st direction, and the direction which flows to an adverse current turns into the 2nd direction. Moreover, an exhaust pipe 9, an exhaust pipe 11, an exhaust pipe 12, the exhaust pipe 10, the exhaust air selector valve 20, the actuator 21, and the ECU100 grade constitute the adverse current means of exhaust gas. moreover, since the air-fuel ratio (RIN -- or rich) and exhaust gas temperature (elevated temperature) of exhaust gas required for SOx removal have been obtained by the operation control of an engine 1, ECU100 containing each sensor for performing the operation control of an engine 1 constitutes control means from a gestalt of this operation

[0066] Moreover, although the gestalt of this operation showed the example which formed the three way component catalyst 40 in the upstream of a catalytic converter 30, you may form a three way component catalyst 40 in the downstream of a catalytic converter 30. As an example which forms a three way component catalyst 40 in the downstream of a catalytic converter 30, the example established in the middle of an exhaust pipe 10 can be given.

[0067] [Gestalt 2 of operation] Next, the gestalt of operation of the 2nd of the exhaust emission control device of the internal combustion engine concerning this invention is explained with reference to the flow view of drawing 7.

[0068] The gestalt of this 2nd operation shows the example of control at the time of giving the function of S trap material to the three way component catalyst 40 shown with the gestalt of the 1st operation. The three way component catalyst 40 in this case emits SOx which absorbed SOx when the air-fuel ratio of inflow exhaust gas was RIN, and was absorbed at the time of low SUTOIKI of an oxygen density, or a rich air-fuel ratio.

[0069] Thus, since a three way component catalyst 40 will be located in the upstream rather than a catalytic converter 30 when S trap function was given to the three way component catalyst 40 and the valve element of the exhaust air selector valve 20 is made into a forward-feed position as shown in drawing 1 (at namely, the time of NOx absorption), a three way component catalyst 40 can be adsorbed, and SOx in exhaust gas can prevent the inflow of SOx to a catalytic converter 30, and can prevent SOx poisoning of the NOx catalyst 31. However, if the exhaust air air-fuel ratio of an engine 1 is controlled to SUTOIKI, since SOx will be emitted from a three way component catalyst 40, the problem of SOx poisoning of the NOx catalyst 31 arises.

[0070] Then, with the gestalt of this operation, ECU100 performs change control of the valve element position of the exhaust air selector valve 20 as follows. First, in Step S11, ECU100 judges whether it is a bulb operation stage. If it judges that it is not a bulb operation stage, a return will be carried out and it will return to a start. A bulb is located in a bypass position (the 3rd position) while changing the valve element (bulb) of the exhaust air selector valve 20 from a forward-feed position to an adverse current position by operation control of an actuator 21, while progressing to Step S12 and controlling compulsorily the exhaust air air-fuel ratio of an engine 1 to SUTOIKI, when it is judged that it is a bulb operation stage.

[0071] If an exhaust air air-fuel ratio is controlled by SUTOIKI, although SOx will be emitted from a three way component catalyst 40, since a bulb is in a bypass position, the exhaust gas containing SOx bypasses the NOx catalyst 31, and is emitted to the atmosphere. Thereby, SOx poisoning of the NOx catalyst 31 is prevented.

[0072] By execution of Step S12, where a bulb is located in a bypass position, it shifts to Step S13. At this step S13, when it judges whether SOx discharge of a three way component catalyst 40 was completed and judges with SOx discharge un-completing, it returns to Step S12. When it judges with the completion of SOx discharge, it progresses to Step S14, and it changes to the bulb change position (adverse current position) made into the purpose, and change control of a bulb is completed.

[0073] If change control of a bulb is completed in Step S14, it will shift to Step S15. ECU100 controls an engine 1 by Step S15 to RIN rich spike operation etc. at the air-fuel ratio according to the operational status, or a compulsive target. The return of after step S15 shift is carried out, and it returns to a start.

[0074] In addition, the above flows of control are similarly performed, when changing a bulb from an adverse current position to a forward-feed position. Moreover, when once stopping the operation of a bulb in an exhaust air bypass position when controlling compulsorily the exhaust air air-fuel ratio of an engine 1 to SUTOIKI in this way changes throw ***** of exhaust gas to a forward feed or an adverse current in consideration of the point which the rate of NOx purification of the NOx catalyst 31 correlates with the degree of catalyst temperature so that the degree of catalyst temperature may not separate from a temperature window, it performs similarly.

[0075] In addition, in the gestalt of operation mentioned above, although discharge processing of NOx from the NOx catalyst 31 and SOx is performed simultaneously, since the amounts of SOx(es) contained in the exhaust gas of an engine, especially the exhaust gas of a gasoline engine are very few, it is not necessary to perform discharge processing of SOx by the same frequency as discharge processing of NOx. then, when performing discharge processing of NOx and exhaust gas temperature is the operational status of the low engine 1 in comparison even if it is SUTOIKI or the operation region of a rich air-fuel ratio Pour exhaust gas by the forward feed same to a catalytic converter 30 as the time of NOx absorption, and it is made to make NOx emit and return from the NOx catalyst 31. At the times of

the operational status of the engine 1 which is SUTOIKI or the operation region of a rich air-fuel ratio, and exhaust gas temperature rises and becomes an elevated temperature on the other hand, such as at the time of acceleration and heavy load operation etc. That is, only when the state of exhaust gas becomes SUTOIKI advantageous to SOx discharge or a rich air-fuel ratio, and an elevated temperature, the valve element of the exhaust air selector valve 20 may be changed to an adverse current position, the flow of the exhaust gas which flows a catalytic converter 30 may be made an adverse current, and you may control to perform discharge processing of SOx.

[0076] Moreover, it judges whether the NOx catalyst 31 needs to be SOx discharge processed by ECU100. The flow of the exhaust gas which holds the valve element of the exhaust air selector valve 20 in a forward-feed position, and flows a catalytic converter 30 when judged with having no need for SOx discharge processing is made into a forward feed. When judged with there being need, the valve element of the exhaust air selector valve 20 is changed to an adverse current position. The flow of the exhaust gas which flows a catalytic converter 30 is made an adverse current. and ECU100 The optimal target air-fuel ratio for discharge and the degree of target catalyst temperature of SOx are computed, when it has reducing-agent addition equipment further, the amount of target reducing agents is computed, an engine 1, reducing-agent addition equipment, etc. are controlled to become these desired value, and it may be made to perform discharge processing of SOx.

[0077] [Gestalt 3 of operation] Next, the gestalt of operation of the 3rd of the exhaust emission control device of the internal combustion engine concerning this invention is explained with reference to drawing 8 - drawing 11 .

[0078] Drawing 8 is drawing showing the outline composition of the exhaust emission control device of the internal combustion engine in the gestalt of the 3rd operation. If the point that the three way component catalyst is not prepared in a flueway is removed in the example shown in this drawing, it is fundamentally [as the 1st of the point, and 2nd operation gestalten] the same.

[0079] Namely, an engine 1 is a RIN barn gasoline engine of an in-series 4-cylinder. Inhalation of air is supplied to each cylinder through an inlet pipe 2 and an inlet manifold 3. Fuel is injected from a fuel injection valve 7 by each inhalation-of-air path which stands in a row in each cylinder, and the exhaust gas discharged from each cylinder is exhausted through an exhaust manifold 8 and an exhaust pipe 9. The throttle valve 4 and air flow meter 6 which equipped the inlet pipe 2 with the throttle position sensor 5 are installed. An exhaust gas temperature sensor 13 is installed in an exhaust pipe 11, and the rotational frequency sensor 14 is installed in an engine 1. It is the composition that each output signal of a throttle position sensor 5, an air flow meter 6, an exhaust gas temperature sensor 13, and the rotational frequency sensor 14 is outputted to ECU100, and operation control of the fuel injection valve 7 is carried out based on the output signal from ECU100.

[0080] Moreover, the exhaust pipe 9 is connected to the 1st port of the exhaust air selector valve (flow direction change means) 20 equipped with four ports. The 2nd port of the exhaust air selector valve 20 is connected to the exhaust pipe (the 2nd flueway) 10 which discharges exhaust gas to the atmosphere, the 3rd port of the exhaust air selector valve 20 is connected to entrance 30a of a catalytic converter (exhaust air purification means) 30 through an exhaust pipe (the 3rd flueway) 11, and the 4th port of the exhaust air selector valve 20 is connected to outlet 30b of a catalytic converter (exhaust air purification means) 30 through the exhaust pipe (the 4th flueway) 12. The occlusion reduction-type NOx catalyst 31 is held in the catalytic converter 30.

[0081] The exhaust air selector valve 20 is a bulb into which the flow direction of the exhaust gas which flows a catalytic converter 30 is changeable by changing to the adverse current position (the 2nd position) which shows the valve element to the forward-feed position (the 1st position) shown in drawing 8 , and drawing 9 . When the aforementioned valve element is located in a forward-feed position, the exhaust air selector valve 20 connects an exhaust pipe 10 and an exhaust pipe 12 while connecting an exhaust pipe 9 and an exhaust pipe 11, and at this time, exhaust gas flows in order of the exhaust pipe 9 -> exhaust pipe 11 -> catalytic-converter 30 -> exhaust pipe 12 -> exhaust pipe 10, and it is emitted to the atmosphere.

[0082] Moreover, when the valve element of the exhaust air selector valve 20 is located in the adverse

current position shown in drawing 9 , the exhaust air selector valve 20 connects an exhaust pipe 10 and an exhaust pipe 11 while connecting an exhaust pipe 9 and an exhaust pipe 12, and at this time, exhaust gas flows in order of the exhaust pipe 9 -> exhaust pipe 12 -> catalytic-converter 30 -> exhaust pipe 11 -> exhaust pipe 10, and it is emitted to the atmosphere.

[0083] Moreover, when the valve element of the exhaust air selector valve 20 is located in a center valve position (refer to drawing 3), the exhaust air selector valve 20 connects an exhaust pipe 9 and an exhaust pipe 10, and at this time, exhaust gas flows in order of the exhaust pipe 9 -> exhaust pipe 10, and it is emitted to the atmosphere.

[0084] In order to secure the degree of NOx catalyst floor temperature in case the flow of exhaust gas is a forward feed also about the arrangement position to the flueway of a catalytic converter 30, entrance 30a of a catalytic converter 30 is considering as the arrangement located near the exhaust air selector valve 20. That is, passage length until exhaust gas flows into a catalytic converter 30 has a direction shorter than the time of making a valve element into an adverse current position when making the valve element of the exhaust air selector valve 20 into a forward-feed position. Therefore, a temperature reduction is so large that exhaust gas temperature will fall according to a thermolysis phenomenon and passage length will become long, if exhaust gas is poured to an exhaust pipe. Therefore, the temperature reduction of exhaust gas until the direction when locating a valve element in an adverse current position flows into a catalytic converter 30 is larger than the time of locating the valve element of the exhaust air selector valve 20 in a forward-feed position.

[0085] On the other hand, as shown in drawing 5 , the rate of NOx purification of the NOx catalyst 31 has the degree of catalyst temperature, and correlation, and it has the optimal temperature window for absorbing NOx, and if it separates from this NOx absorption temperature window, NOx absorptance will decline sharply. Moreover, even if it does not make temperature of the NOx catalyst 31 so high, NOx can be made to emit, when making NOx emit and return from the NOx catalyst 31.

[0086] Moreover, although the exhaust air gas cleanup temperature window of the NOx catalyst 31 is 250 degrees C - about 550 degrees C as shown in drawing 10 , it is that the high rate of purification is obtained before and after 400 degrees C. Usually, although it was made to control so that the temperature of a catalyst is controlling the degree of floor temperature of this NOx catalyst near 400 degree C, the problem discharged outside a vehicle without purifying exhaust gas, in order for exhaust gas to carry out a short pass during a valve element operation and to bypass a catalytic converter 30 temporarily, if the valve element of the exhaust air selector valve 20 is operated arises.

[0087] That is, although the view which controls the exhaust air air-fuel ratio of an engine to SUTOIKI is adopted with the gestalt of the previous 1st and previous operation of the 2nd at the time of the bypass of exhaust gas while changing the exhaust air selector valve 20 positively, in order to lessen the problem which exhaust gas bypasses as much as possible, it is also effective that it is made not to perform change control of the exhaust air selector valve 20, either as much as possible.

[0088] Then, when the temperature of the NOx catalyst 31 was in catalytic activity temperature, the valve element of the exhaust air selector valve 20 was not operated, and when it became more than catalytic activity temperature or below catalytic activity temperature, it was made to perform change control with the gestalt of this operation. Although influenced by the kind of catalyst about this catalytic activity temperature, it is the range of 250 degrees C - 550 degrees C in general. As for this temperature requirement, it is desirable to consider as the capacity below the half of the NOx occlusion capacity (the amount of NOx(es) absorbable at unit time) in near 400 degree C the highest activity is obtained.

[0089] Drawing 11 is a flow chart which shows the control procedure to which ECU100 performs the valve element operation of the exhaust air selector valve 20, when the temperature of the NOx catalyst 31 was in catalytic activity temperature in this way, and the valve element of the exhaust air selector valve 20 is not operated and it becomes more than catalytic activity temperature or below catalytic activity temperature.

[0090] first, the step S21 -- setting -- ECU100 -- the degree of catalyst floor temperature of the NOx catalyst 31 -- 550 degrees C or more -- or 250 degrees C or less of those judgments are performed Here, when it is judged that the degree of catalyst floor temperature is 550 degrees C or more, it shifts to Step

S22, and when it is judged that it is 250 degrees C or less, the valve element position of the exhaust air selector valve 20 is considered as present condition maintenance, carries out a return, and it returns to a start.

[0091] At Step S22, the degree of catalyst floor temperature judges whether it is 550 degrees C or more, and, in the case of 550 degrees C or more, it shifts to Step S23, and, in the case of 550 degrees C or less, shifts to Step S25. At Step S23, when it judges whether the valve element of the exhaust air selector valve 20 is in a forward-feed position (the 1st position) and is in a forward-feed position, after shifting to Step S24 and changing the valve element of the exhaust air selector valve 20 to an adverse current position (the 2nd position), a return is carried out and it returns to a start. Since [that the length of a flueway is / the direction in case exhaust gas flows backwards / long] the temperature reduction is large, the degree of catalyst floor temperature can be reduced. In Step S23, when it judges with the valve element of the exhaust air selector valve 20 being in an adverse current position, a return is carried out and it returns to a start.

[0092] At Step S25 which shifts on the other hand when the degree of catalyst floor temperature is 550 degrees C or less, it judges whether the valve element of the exhaust air selector valve 20 is in a forward-feed position. When it is in a forward-feed position, it considers as present condition maintenance, and a return is carried out and it returns to a start. In this step S25, when it is judged that the valve element of the exhaust air selector valve 20 is in an adverse current position, it shifts to Step S26, and after performing control which changes the valve element of the exhaust air selector valve 20 to a forward-feed position, it returns to a start.

[0093] Thus, if it is in the catalytic activity temperature of the NOx catalyst 31 according to the gestalt of the 3rd operation, the valve element of the exhaust air selector valve 20 which changes the flow direction of exhaust gas will not be operated, and will be made into the state where the valve element of the exhaust air selector valve 20 was held they to be [any of a forward-feed position or an adverse current position]. And when the degree of catalyst temperature becomes more than catalytic activity temperature or the following, change control of a flow direction change means is performed for the first time. It can be coped with by the simple method of only change control of the problem in which the flow of the exhaust gas which bypasses an exhaust air purification means exists by this of the exhaust air selector valve 20. That is, since it is made for the rate of purification to change the exhaust air selector valve 20 out of a low catalytic activity temperature requirement primarily, an exhaust air purification performance can be raised as a whole.

[0094]

[Effect of the Invention] After a flow direction change means operates a three way component catalyst at the time of ***** gill **** and purifies exhaust gas in the position which bypasses an exhaust air purification means at it by controlling the exhaust air air-fuel ratio of an internal combustion engine to SUTOIKI at the time of the operation of a flow direction change means, it can be made to discharge according to the exhaust emission control device of the internal combustion engine concerning the 1st means of this invention. Therefore, during the operation of the flow direction change means of exhaust gas, though the flow of the exhaust gas which bypasses an exhaust air purification means arises, this can be purified and discharged.

[0095] After the exhaust-air air-fuel ratio of an internal combustion engine stops the operation of a flow-direction change means temporarily in an exhaust-air bypass position since SOx is emitted from a three way component catalyst at the time of SUTOIKI, and SOx discharge is completed, it is changing a flow-direction change means, and, according to the exhaust emission control device of the internal combustion engine concerning the 2nd means of this invention, SOx poisoning of an exhaust-air purification means can prevent effectively in what gave a SOx absorption function to a three way component catalyst.

[0096] If the catalyst of an exhaust air purification means is in catalytic activity temperature according to the exhaust emission control device of the internal combustion engine concerning the 3rd means of this invention, the flow direction change means of exhaust gas will not be operated, and will be made into the state where the change means was held they to be [any of a forward-feed position or an adverse

current position]. And it can be coped with by the simple method of only change control of the problem in which the flow of the exhaust gas which bypasses an exhaust air purification means exists by performing change control of a flow direction change means for the first time when the degree of catalyst temperature becomes more than catalytic activity temperature or the following of a flow direction change means. That is, an exhaust air purification performance can be raised as a whole because the rate of purification changes a flow direction change means out of a low catalytic activity temperature requirement primarily.

[Translation done.]

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PRIOR ART

[Description of the Prior Art] In order to purify the exhaust gas discharged from an internal combustion engine, generally an exhaust emission control device is installed in the flueway of an internal combustion engine. If the exhaust gas of an internal combustion engine is poured to this exhaust emission control device, a sediment will adhere gradually from the upstream in an exhaust emission control device. What this sediment is changes with composition of exhaust gas, or mechanisms of the composition of an exhaust emission control device, and exhaust air purification, for example, it has an oxide, a sulfide, a nitrate, a sulfate, etc. This sediment needs to reduce the purification performance of an exhaust emission control device, or may cause increase of an exhaust back pressure and needs to remove it to predetermined timing.

[0003] For example, there is an occlusion reduction-type NOx catalyst as an exhaust emission control device which purifies NOx of the exhaust gas discharged from the internal combustion engine which burns a RIN air-fuel ratio. This occlusion reduction-type NOx catalyst is a catalyst which emits NOx which absorbed NOx when the air-fuel ratio of inflow exhaust gas was RIN, and was absorbed when the oxygen density in inflow exhaust gas fell, and returns to N₂. NOx emitted while making NOx absorbed from the aforementioned occlusion reduction-type NOx catalyst by making rich the air-fuel ratio of the exhaust gas which arrange an occlusion reduction-type NOx catalyst to a flueway, nitrogen oxide (NOx) is made to absorb from the exhaust gas of a RIN air-fuel ratio, and increase in quantity etc. carries out fuel supplied to an internal combustion engine after NOx absorption, and flows into the aforementioned occlusion reduction-type NOx catalyst emit -- unburnt [in exhaust gas] -- reduction purification carries out by reduction components, such as HC and CO, N₂

[0004] By the way, if the sulfur content is contained in the fuel for an internal combustion engine and fuel is generally burned with an internal combustion engine, the sulfur content in fuel will burn and a sulfur oxide (SOx) will occur. Since the aforementioned occlusion reduction-type NOx catalyst absorbs SOx in exhaust gas by the same mechanism as performing the absorption of NOx, if an occlusion reduction-type NOx catalyst is arranged to the flueway of an internal combustion engine, not only NOx but SOx will be absorbed by the occlusion reduction-type NOx catalyst.

[0005] However, SOx absorbed by the occlusion reduction-type NOx catalyst is easy to tend be accumulated in an occlusion reduction-type NOx catalyst that it decomposes and is hard to be emitted on the conditions which perform discharge of NOx from an occlusion reduction-type NOx catalyst, and reduction purification (henceforth NOx discharge / reduction processing) in order to form a stable sulfate with time progress. Increase of the SOx accumulated dose within an occlusion reduction-type NOx catalyst produces the so-called SOx poisoning to which the NOx absorption capacity of an occlusion reduction-type NOx catalyst decreases, it becomes impossible to fully remove NOx in exhaust gas, and NOx purification efficiency falls. Then, in order to continue at a long period of time and to maintain highly the NOx decontamination capacity of an occlusion reduction-type NOx catalyst, it is necessary to make SOx absorbed by the catalyst emit to proper timing.

[0006] In order to make SOx absorbed by the occlusion reduction-type NOx catalyst emit, it turns out that it is necessary make rich the air-fuel ratio of inflow exhaust gas, and to make an occlusion

reduction-type NOx catalyst into an elevated temperature rather than the time of NOx discharge / reduction processing.

[0007] By the way, the distribution of the absorbed dose of SOx within an occlusion reduction-type NOx catalyst has increased, so that it is close to the entrance side of exhaust gas in an occlusion reduction-type NOx catalyst. therefore, in case SOx absorbed by the occlusion reduction-type NOx catalyst is made to emit, by having passed in the same direction as the flow direction of the exhaust gas at the time of NOx absorption, the exhaust gas of a rich air-fuel ratio Even if SOx absorbed by the aforementioned entrance side in the occlusion reduction-type NOx catalyst is emitted There is a problem that a resorption will be carried out to an occlusion reduction-type NOx catalyst, and it cannot discharge efficiently from an occlusion reduction-type NOx catalyst only by emitted SOx moving the inside of an occlusion reduction-type NOx catalyst to the outlet side of exhaust gas.

[0008] Then, when making SOx absorbed by the occlusion reduction-type NOx catalyst emit as indicated by JP,7-259542,A, the technology of pouring the exhaust gas of a rich air-fuel ratio for an occlusion reduction-type NOx catalyst with the time of NOx absorption at an opposite direction is proposed. Thus, if it has the adverse current function which makes the flow of exhaust gas reverse and emits SOx, since the travel within an occlusion reduction-type NOx catalyst comes to be immediately discharged besides an occlusion reduction-type NOx catalyst few, SOx emitted from the occlusion reduction-type NOx catalyst can prevent that the resorption of the emitted SOx is carried out to an occlusion reduction-type NOx catalyst.

[0009] In the case of the exhaust emission control device of the internal combustion engine with an adverse current function currently indicated by the aforementioned official report Prepare the bypass path which makes an occlusion reduction-type NOx catalyst bypass, and a passage selector valve is prepared in the unification portion of the flueway and the aforementioned bypass path which stand in a row for an occlusion reduction-type NOx catalyst, respectively. Furthermore, between an occlusion reduction-type NOx catalyst and the aforementioned passage selector valves of the side near [this] an internal combustion engine is connected to the suction mouth of an exhaust air pump. When connecting the delivery of an exhaust air pump to a bypass path and making SOx emit from an occlusion reduction-type NOx catalyst While changing the valve position of the two aforementioned passage selector valves so that the whole quantity of exhaust air of an internal combustion engine may flow to a bypass path, with the time of the usual NOx absorption, the flow of the exhaust air which flows an occlusion reduction-type NOx catalyst to an opposite direction is generated by operating an exhaust air pump.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is an outline block diagram in the gestalt of operation of the 1st of the exhaust emission control device of the internal combustion engine concerning this invention, and is drawing showing the time of locating an exhaust air selector valve in a forward-feed position.

[Drawing 2] In the exhaust emission control device of the gestalt of the 1st operation, it is drawing showing the important section when locating an exhaust air selector valve in an adverse current position.

[Drawing 3] In the exhaust emission control device of the gestalt of the 1st operation, it is drawing showing the important section when locating an exhaust air selector valve in a center valve position.

[Drawing 4] It is drawing explaining NOx absorption/emission and a reduction operation of an occlusion reduction-type NOx catalyst.

[Drawing 5] It is drawing showing the temperature characteristic of the rate of NOx purification of an occlusion reduction-type NOx catalyst.

[Drawing 6] It is the flow chart which shows the control procedure in the exhaust emission control device of the gestalt of the 1st operation.

[Drawing 7] It is the flow chart which shows the control procedure in the gestalt of operation of the 2nd of the exhaust emission control device of the internal combustion engine concerning this invention.

[Drawing 8] It is an outline block diagram in the gestalt of operation of the 3rd of the exhaust emission control device of the internal combustion engine concerning this invention, and is drawing showing the time of locating an exhaust air selector valve in a forward-feed position.

[Drawing 9] In the exhaust emission control device of the gestalt of the 2nd operation, it is drawing showing the important section when locating an exhaust air selector valve in an adverse current position.

[Drawing 10] It is drawing showing the catalytic activity temperature requirement based on the temperature characteristic of the rate of NOx purification of an occlusion reduction-type NOx catalyst.

[Drawing 11] It is the flow chart which shows the control procedure in the gestalt of operation of the 3rd of the exhaust emission control device of the internal combustion engine concerning this invention.

[Description of Notations]

- 1 RIN Barn Gasoline Engine (Internal Combustion Engine)
- 2 Inlet Pipe (Inhalation-of-Air Path)
- 6 Air Flow Meter
- 7 Fuel Injection Valve
- 9 Exhaust Pipe
- 10 Exhaust Pipe
- 11 Exhaust Pipe
- 12 Exhaust Pipe
- 13 Exhaust Gas Temperature Sensor
- 14 Rotational Frequency Sensor

20 Exhaust Air Selector Valve (Flow Direction Change Means)
21 Actuator (Control Means)
30 Catalytic Converter
31 NOx Catalyst (SOx Absorbent)
30a Entrance
30b Outlet
40 Three Way Component Catalyst
100 ECU (Control Means)

[Translation done.]

* NOTICES *

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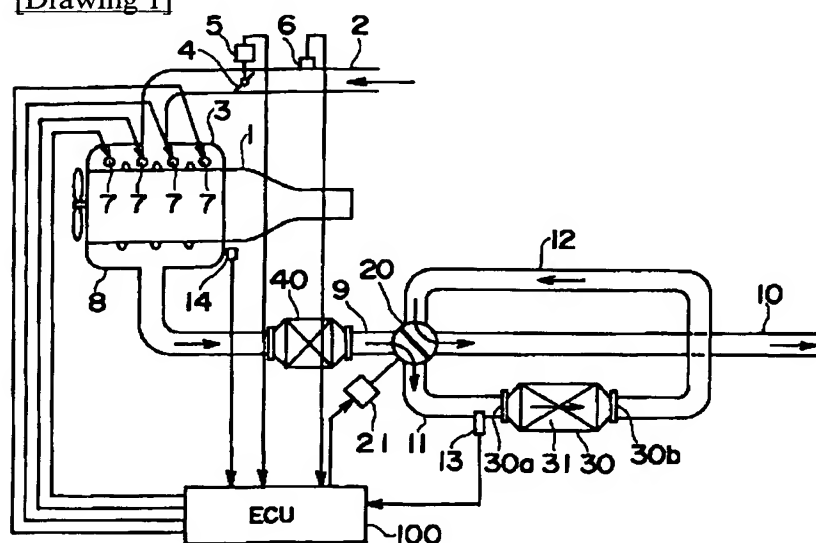
1. This document has been translated by computer. So the translation may not reflect the original precisely.

2. **** shows the word which can not be translated.

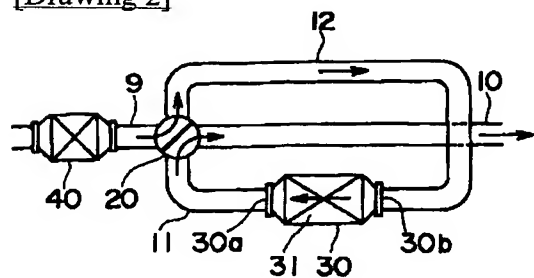
3. In the drawings, any words are not translated.

DRAWINGS

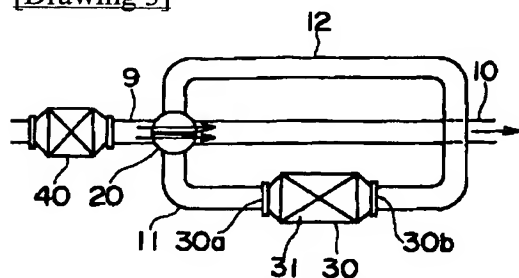
[Drawing 1]



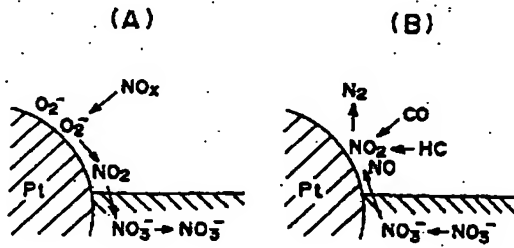
[Drawing 2]



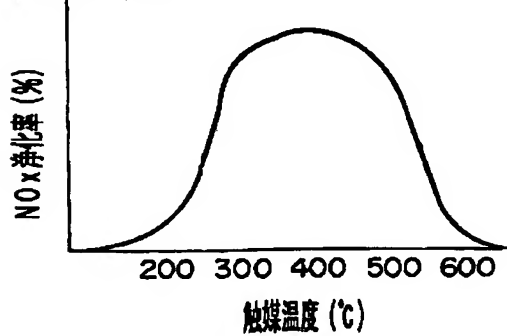
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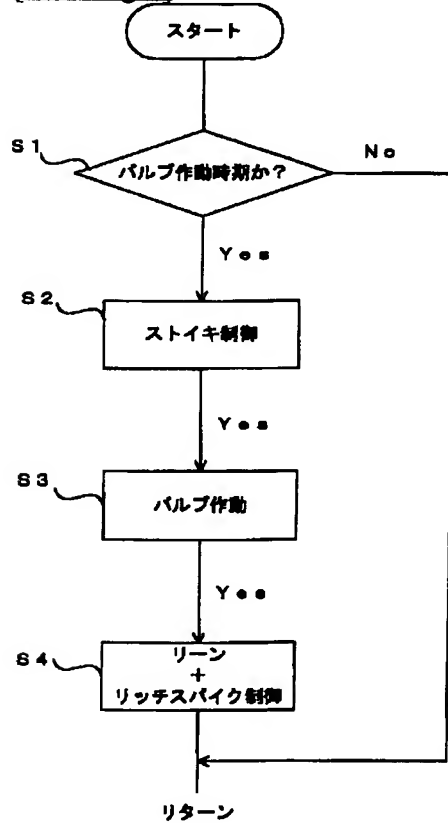
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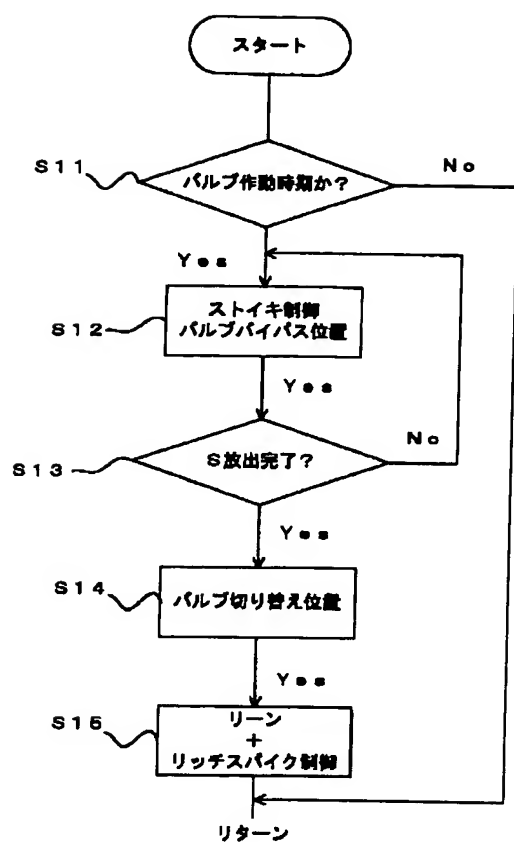
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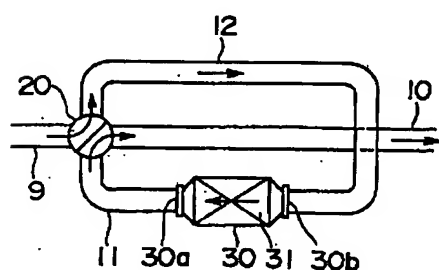
[Drawing 6]



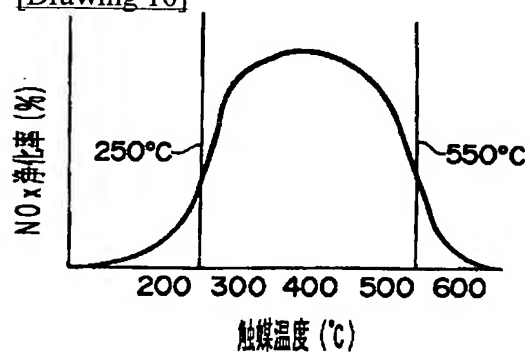
[Drawing 7]



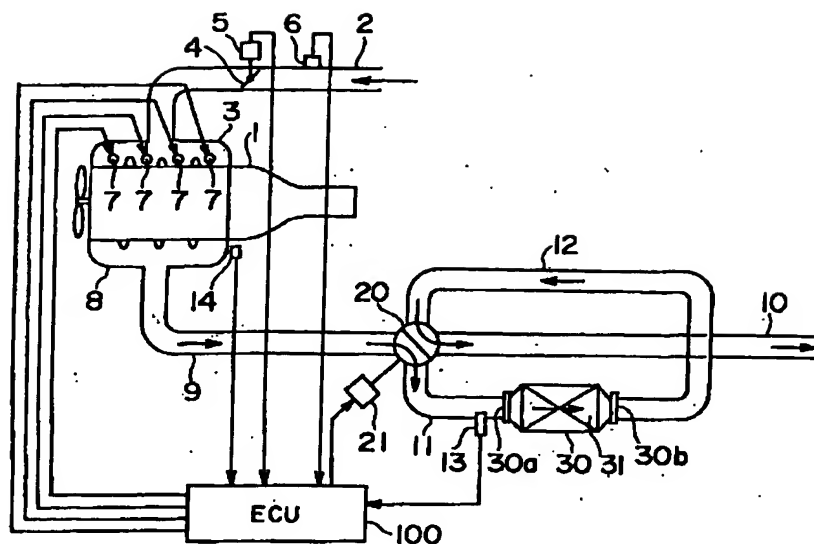
[Drawing 9]



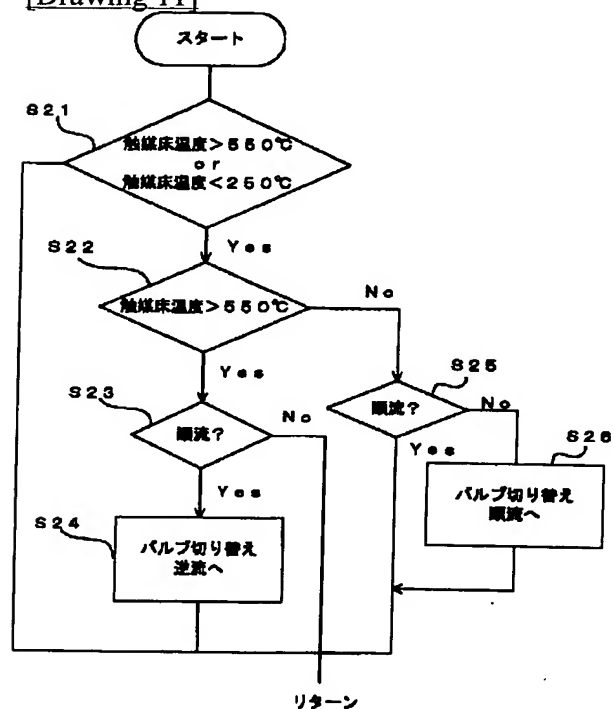
[Drawing 10]



[Drawing 8]



[Drawing 11]



[Translation done.]